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USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

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AEROSPACE AND ELECTRONIC SYSTEMS

UDC: 681.3-181.48

DIGITAL IMITATOR OF DECCA RADIO NAVIGATION SYSTEM SIGNALS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 6, Jun 85 (manuscript received 12 Nov 84) pp 25-32

[Article by V.D. Luginin and G.N. Andryushov, Leningrad Higher Engineering Marine School imeni Admiral S.O. Makarov]

[Abstract] A study is made of the principles of design of an imitator designed to model the physical signals of a chain of stations in the DECCA radio navigation system. The two main functional tasks of the imitator are to formulate the operating diagram of the chain of stations in the MP mode andccalculate values of the navigation parameter for each station considering the statistical conditions of propagation of radio waves, with subsequent synthesis of the physical signal. The imitator can model the field of signals after reception considering movement of the object as well as radio wave propagation conditions. Figures 3; references: 9 Russian.

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CSO: 1860/34

UDC 621.396.96.03.001

DETERMINATION OF PROBABILITY CHARACTERISTICS OF INTERFERENCE AND ITS MIXTURE WITH NARROW-BAND SIGNAL FROM EXPERIMENTAL DATA

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 10 Jan 83) pp 1742-1747

[Article by V.D. Rubtsov and A.N. Zaytsev]

[Abstract] In order to avoid errors inevitable in mathematical simulation of interference, a scheme is proposed for determining the probability distribution of interference appearing in mixture with a narrow-band signal directly from experimental data. According to this method, the probability density of instantaneous interference levels is calculated from measured distributions of the envelopes representing separately atomspheric interference and industrial interference. These curves are plotted with $\Delta=20 \log R(E/\sqrt{\bar{E}}$ as the ordinate and P (%) as the abscissa, with $V_d=20 \log (\sqrt{\bar{E}^2}/\bar{E}$ as parameter (P=0.01p -probability of interference exceeding a level R within a fraction of time p, E- instantaneous ordinate of envelope, $\sqrt{\bar{E}^2}$- rms ordinate of envelope). The probability P is plotted along the axis of abscissas to the double-log scale $\xi(P)=\log_{10}\log_e(\frac{1}{p})$. Interference recorded by a narrow-band receiver is represented in the form $\zeta(t) = E(t)\cos[\omega_0 t - \phi(t)] = X(t)\cos\omega_0 t + Y(t)\sin\omega_0 t$. The relative discrepancy between the probability density $W(\zeta,t)$ based simulation and the probability density $W(\zeta,t)$ based on measurement is characterized by the difference $\delta I_{1,2,3.4} = \frac{I_m - I_e}{I_e}$ % between the respective first four distribution moments I_m (model) and I_e (experiment): 1 = M (mathematical expectation, 2 = D (dispersion, 3 = S^e (skew), 4 = K (kurtosis). Numerical data indicate that the thus approximated experimental distributions of atmospheric interference and industrial interference envelopes closely approach the log normal distribution model. Figures 5; tables 1; references 7: 4 Russian, 3 Western.

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FOCUSING CHARACTERISTICS OF FRESNEL ZONE PLATE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 12 May 83) pp 1681-1688

[Article by F.Kh. Baybulatov, I.V. Minin and O.V. Minin]

[Abstract] An amplitudinal Fresnel zone plate is considered as focusing element, specifically as radio objective with frequency-dependent focal length, its resolving power being the same as that of a dielectric lens with equal aperture but also remaining insensitive to small frequency fluctuations. The electromagnetic field in the focal region is calculated according to the Fresnel-Kirchhoff scalar theory of diffraction, assuming that the source is located at a finite distance from the plate and oriented coaxially relative to it. For an experimental evaluation, a circular plate was designed for the 2.37 mm radiation wavelength within the 1.9-2.4 mm diffraction band and placed 1000 mm away from the source - a distance equal to its focal length. The plate was made of metal-clademicarta foil, with 52 binary amplitude zones and with the radius of the outermost zone not smaller than the focal length or distance to the source. The test equipment consisted of a backward-wave tube as source of microwave radiation with power supply, a D-407 silicon diode or a Schottky-barrier detector diode as radiation probe for scanning free space, a waveguide-type pin-diode modulator, and an attenuator. Measuring and recording instruments included a signal generator, a wave meter, two selective nanovoltmeter, one with a microwave source, a digital voltmeter, and an oscillograph. The results of measurements, longitudinal and transverse intensity profiles defining the location of the focus, agree with numerical calculations based on theory within the measurement accuracy. Figures 4; tables 1; references 7: 4 Russian, 3 Western (1 in Russian translation).

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UDC 621.396.67.012.12:537.874.4

DIRECTIONAL CHARACTERISTICS OF ANTENNAS IN TURBULENT ATMOSPHERE WITH SHORT AVERAGING PERIOD. GEOMETRICAL CHARACTERISTICS OF RADIATION PATTERN

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 28 May 84) pp 1695-1701

[Article by A.G. Vinogradov and Z.I. Feyzulin]

[Abstract] Directional characteristics of antennas are analyzed and evaluated on the basis of a model applicable to short-duration measurements and short averaging period, typically in a turbulent atmosphere. The underlying realistic premise is that the difference between a random radiation pattern and the quiescent one consists of two components, namely random displacements and random distortions. Both components are estimated in terms of their statistical moments, mean-value and dispersion as well as skew, assuming that extreme values do not differ appreciably from instantaneous ones. The major lobe and n minor lobes are determined accordingly, with the aid of correlation analysis, in terms of their maxima and minima as well as asymmetry index. Numerical data are shown for a turbulent medium with a Kolmogorov-Obukhov fluctuation spectrum of the refractive index: $D_\phi(x) = (x \cdot \sin\theta^0/r_c)^{5/3}$ (θ^0- angle between antenna axis and direction of wave propagation, r_c- coherence radius proportional to $(C_\varepsilon^2)^{-3/5}$, C_ε^2- turbulence pattern parameter). The authors thank S.M. Rytov for interest, helpful suggestions and discussions, and V.P. Goldin for making all computer calculations. Tables 1; references: 9 Russian.

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UDC 537.876.23.001.573

DESCRIPTION OF TRANSIENT EXCITATION PROCESSES IN PLANAR DIELECTRIC STRUCTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 26 Nov 84) pp 1702-1708

[Article by G.I. Veselov, A.I. Kirpa and N.I. Platonov]

[Abstract] The problem of transient excitation in an open dielectric structure is solved in the one-dimensional approximation for a plane layer (dielectric permittivity ε_1 and magnetic permeability μ_1) of uniform thickness α bounded by an ideal conducting or ideal magnetic material on the $x = 0$ and by another real material (ε_2, μ_2) on the $x = \alpha$ side. The layer is excited by a laterally entering transverse current of

density $J=J_y(x,t)y_0$ at time $t>0$, with $J_y(x,t) = 0$ at time $t\leq 0$. Dispersion of the media and energy dissipation in them are disregarded. The electromagnetic field is described by Maxwell equations, its y-components in the direction of current flow satisfying the particular nonhomogeneous wave equation. Both dielectric permittivity and magnetic permeability of the structure are piecewise-constant functions of the normal coordinate changing stepwise at the interfaces. The boundary conditions are zero field components at $x=0$ and continuity of tangential components at $x=a$. The initial conditions are zero field components and their first time derivatives. The problem is solved in quadratures of the Green function, by the method of Laplace transformation. An analytical and then numerical solution has been obtained for the important special practical case of a harmonic excitation pulse. Figures 3; references 9: 4 Russian, 5 Western.

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CSO: 1860/87

UDC 621.372.85-408.8.001.5

OPTIMUM SPACE-TIME PROCESSING OF SIGNALS IN MOVING RADAR STATION WITH TWO-DIMENSIONAL ANTENNA ARRAY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85 (manuscript received 27 Jul 83) pp 1734-1741

[Article by G.S. Kondratenkov, M.A. Mironov, V.N. Antipov and A.T. Abrarov]

[Abstract] A moving radar station with a two-dimensional antenna array is considered, and the optimum algorithm of composite space-time processing of its output signals is constructed for the specific case where information about the two angular coordinates of a target is carried by the location of the wavefront in the antenna aperture and by the phase modulation of the signal respectively. The radar station is referred to a system of Cartesian coordinates which does not rotate but moves along some trajectory relative to the stationary terrestrial system of coordinates. The antenna is assumed to be a plane vertical one consisting of elements equidistant in both vertical and horizontal directions with different pitches in each. The optimum structure of the signal processor is synthesized according to the equations of nonlinear filtration in the Gaussian approximation, with finite differences replacing the derivatives of signals with respect to the distance coordinate and the two angular coordinates. Essentially, the echo signal appearing at the input of a monopulse antenna is convereted into one sum signal and two difference signals at the output of this antenna. These signals are then strobed with respect to distance and multiplied by the reference signal in corresponding phase detectors. The attainable accuracy of such radar measurements and processing is estimated on the basis of the equation for the matrix of a posteriori second central moments of relative filtration errors, assuming that the coordinates estimation errors are not larger than the widths of linear segments along

the discriminator characteristic. The error of azimuth and elevation estimates increases, that of the elevation angle more than that of the azimuth angle, as the rate of phase modulation decreases. Figures 5; references 12: 11 Russian, 1 Western (in Russian translation).

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FIELD SINGULARITY AT EDGE OF CONDUCTING WEDGE WITH BOUNDARY BETWEEN GYROTROPIC MEDIUM AND AIR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85 (manuscript received 29 Jun 83) pp 1831-1833

[Article by V.V. Fisanov]

[Abstract] A wedge is considered which contains a ferrite sector (gyrotropic medium) and an air sector (isotropic medium), their half-plane boundary originating at the edge, between the two ideally conducting lossless walls. The tensor of relative magnetic permeability of the ferrite material is defined in a cylindrical system of coordinates r,ϕ,z as $\mu=\mu_1(\hat{r}\hat{r} + \hat{\phi}\hat{\phi}) + i\,\mu_2(\hat{r}\hat{\phi} - \hat{\phi}\hat{r}) + \hat{z}\hat{z}$, where $\mu_1 = 1 - R/(\Omega^2 - R^2)$, $\mu_2 = \Omega/(\Omega^2 - R^2)$ ($\Omega = \omega/\omega_M$, $R = \omega_H/\omega_M$, ω- frequency of signal, ω_H- frequency of gyromagnetic resonance, ω_M- frequency of saturation magnetization). With an external magnetic field applied along the edge, the distribution of the magnetic field H_r, $H_\phi = Ar^{\tau-1}$ ($\tau = \sigma + is$) containing a singularity $\sigma = \mathrm{Re}\tau$ near the edge is calculated by the Meixner method for the general cases of the ferrite sector respectively smaller and larger than the air sector. Calculations are based on the caracteristic equation in τ for each case, its solution becoming trivial for $\tau = 0$. The relevant nontrivial solution consists of a general one and any of three particular ones with

$$\sigma_1 = 0,\ \sigma_2 = \frac{\pi}{\phi_2}\frac{m}{2(m-1)},\ \sigma_3 = \frac{\pi}{\phi_2}\frac{m}{2}$$ respectively (ϕ_2- total wedge angle)

corresponding to an anomalously strong singularity, a singularity not weaker than in a homogeneous medium filling the wedge, and a weak singularity ($m = 3$) or no singularity ($m \leq 4$). Figures 1; references 10: 4 Russian, 6 Western (1 in Russian translation).

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COUPLING COEFFICIENT OF ANTENNAS IN MEDIUM WITH SMALL-SCALE INHOMOGENEITIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 14 Dec 83) pp 1838-1840

[Article by T.A. Tsaliyev]

[Abstract] A medium with random small-scale inhomogeneities is considered between two identical linear antenna arrays, a transmitting one and a receiving one. Each array consists of N dipoles with small electrical dimensions, namely a dipole length much smaller than the radiation wavelength. With the two arrays assumed to collinear, the coupling between them through the fields scattered by those inhomogeneities is calculated as the ratio of average power of scattered fields at the receiver's adder to power at the input of the transmitter's adder. This ratio, the coupling coefficient, has been evaluated numerically on a YeS-1022 computer, and found to remain almost constant as the radius R_0 of integration around each antenna exceeds $6d^2/\lambda$ (d- center-to-center distance between antennas, λ- radiation wavelength). It was also found to decrease with increasing electrical dimensions of the two arrays. Figures 1; references: 4 Russian.

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EFFECT OF STATISTICAL RELATION BETWEEN PARTICLES IN RANDOM CLUSTER ON INTENSITY OF SCATTERED ELECTROMAGNETIC FIELD

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 26 Apr 84) pp 1854-1856

REBRIKOV, G. I. and SUDAKOV, V. F.

[Abstract] A rather simple approximation is proposed for calculating the intensity of an electromagnetic field scattered by a random cluster of dipoles, with the statistical distribution of distances between dipoles taken into account. The dimensions of the cluster and the observer's distance from the cluster are assumed to be such that both an incident wave and a reflected wave can be regarded as plane ones. The distances between dipoles are assumed to be larger than the wavelength so that electromagnetic interaction of dipoles and multiple scattering by dipoles become negligible. For an analytical description of the experimental curve representing the intensity of a scattered field as function of time, on the basis of measurements revealing a narrow high intensity peak followed by a wide low one, the distribution of dipoles within the cluster is regarded

as an Erlang flux with limited aftereffect. The mean intensity of a scattered field depends only on the spacing of dipoles along the observation line. The double sum in the expression for that intensity can, by application of the formula for the arithmetic mean of partial Fourier-series sums, be reduced to a plain fraction with the Erlang order k as a principal parameter. This order of normalized Erlang flux represents the statistical correlation of interdipole distances and its value ranges from $k = 0$ for a Poisson flux without aftereffect and independent scattering to $k = \infty$ for a periodic distribution of dipoles and coherent scattering. Figures 2; references 6: 5 Russian, 1 Western (in Russian translation).

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UDC 533.951

EMISSION OF ELECTROMAGNETIC WAVES UPON EXCITATION OF PLASMA-RESONANCE REGION BY MODULATED ELECTRON BEAM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85 (manuscript received 10 Oct 83) pp 1862-1866

[Article by S.M. Levitskiy and I.A. Anisimov]

[Abstract] Emission of electromagnetic radiation from a region of local plasma resonance in a weakly collisional and weakly nonhomogeneous plane multilayer plasma column, following excitation by a modulated infinitely wide electron beam, is evaluated on the basis of the Lorentz lemma mathematically formulating the reciprocity principle. Accordingly, the radiation field is determined from the excitation current and the fields of a probing plane electromagnetic wave so that it becomes unnecessary to solve the problem of excitation by a modulated electron beam. The plasma is assumed to fill the half-space $z < L$ with a linear longitudinal concentration profile $n_e(z) = n_0(1 - z/L)$ at $z \leq L$ and $n_e(z) = 0$ at $z > L$. Nonlinear effects are assumed to remain negligible as long as the electric field in the region of local resonance remains far below the critical level $E^{res} \ll \frac{\omega}{e}\sqrt{mk_BT}$ (ω- signal frequency, T- electron temperature, e and m - charge and mass of an electron, k_B- Boltzmann constant). The problem is formulated as a one-dimensional one and is solved in the fixed-current approximation, disregarding the motion of ions but including the effect of finiteness of the electron temperature on the amplitude of plasma oscillations in the resonance region by introduction of an additional effective collision frequency. Emission of radiation being a transient process here, the results reveal that the intensity of emitted radiation first increases as the length of the plasma column increases from a very small one (when the width of the region of local resonance also increases) and then decreases as the length of the plasma column becomes very large

(when the excitation becomes asynphasal. The authors thank V.N. Orayevskiy and S.S. Moiseyev for helpful suggestions and discussion. References 15: 13 Russian, 2 Western.

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NEW EQUATION OF DIFFRACTION BY MAGNETODIELECTRIC BODIES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 9, Sep 85 (manuscript received, after revision, 26 Nov 84)
pp 3-8

[Article by Yu.Ya. Yurov]

[Abstract] An integral equation describing the diffraction of an electromagnetic field by a magnetodielectric body is derived from a single system of Maxwell equations for the entire space, which requires only that the magnetic permeability μ and the dielectric permittivity ε change smoothly at the boundary of the magnetodielectric medium and thus become continuous functions of the coordinates with continuous derivatives. This integral equation thus couples the two electromagnetic fields, inside the body and outside it, whereupon a change from continuous to discontinuous parameters of the medium can be made - which is not permissible in the original Maxwell equations. The equation is derived in a general curvilinear orthogonal system of coordinates ξ,η,ζ with metric coefficients and with the coordinate surface $\zeta = 0$ being also the surface of the body, both μ and ε being function of this ζ-coordinate. A jumpwise change of μ and ε is considered for each component of the integrand, now in a Cartesian system or a spherical system of coordinates, whereupon sources are included in terms of extraneous fields discontinuous at the body surface so that the equation becomes a nonhomogeneous one. The preference for such an integral equation without boundary conditions or for a system of differential equations with boundary conditions depends on the specific problem. References 5: 4 Russian, 1 Western.

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ADAPTIVE SPACE-TIME FILTRATION OF INTERFERENCE IN MULTICHANNEL SYSTEMS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 9, Sep 85 (manuscript received, after revision, 3 Dec 84)
pp 13-19

[Article by V.I. Samoylenko and I.V. Grubrin]

[Abstract] A method of filtering out interference is proposed which allows adaptation of both the space filter and the time filter behind it, either "independently" each on the basis of its output signal with the input signal to the time filter being the output signal from the space filter, or "simultaneously" on the basis of the common system output signal from the time filter. As criterion of adaptation is selected the minimum mean-square error at the system (time filter) output. The general algorithm of adaptation, involving search for the optimum weight vectors, combines the methods of steepest descent and stochastic approximation. The latter allows the true values of the gradient or the correlation functions to be replaced by their respective instantaneous estimates. The algorithm can be simplified for special practical cases such as adaptation of a time filter only without a space filter in the system or adaptation of a space filter without a time filter in the system, also for adaptation of a space filter with a nonadaptive time filter in the system. The algorithm was tested by simulation of an equidistant linear antenna array consisting of four elements, the pitch being equal to half a wavelength, on a YeS-1055 digital computer. Interference signals were simulated by deterministic trigonometric functions of time $\alpha(t) = A(\cos\omega_0 t + M\sin\Omega t)$ with a wide spectrum. Figures 1; references 12: 6 Russian, 6 Western.

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MUTUAL SYNCHRONIZATION IN SPACED ANTENNA SYSTEMS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 9, Sep 85 (manuscript received, after revision, 17 Dec 84)
pp 71-73

[Article by V.I. Samoylenko and I.Yu. Lygina]

[Abstract] Simultaneous operation of two transmitter antennas with phased arrays each and spaced far apart, the distance between them being much large than the wavelength, requires that the two respective oscillators feeding into them be both frequency and phase locked. In the case of microwave antennas, the distance between them being inherently large, there is an

unstable time dealy in the tie line between them. In this case the reference phase and frequency for both antennas can be established by two auxiliary oscillators with a phase feedback loop around each and with a directional coupler on each side of the delay line between them. The two feedback loops are mutually symmetric, each consisting of a phase detector and a filter in series. The former puts out a voltage proportional to the phase difference and the latter extracts a dynamic voltage which will stabilize when both phase and frequency of the two main oscillators have been steady-state locked. The locking process is described by a system of two nonlinear fourth-order differential equations with delayed feedback, more easily solved by numerical methods on a computer than by analytical methods for the transient period. For the locked steady state this system reduces to a single first-order differential equation easily solved by graphical methods. The lock frequency depends on three system parameters: gain and nominal frequency of the oscillators, and the time delay between them. Figures 3; references: 1 Russian.

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COMPARISON OF SIGNAL EXTRACTION CONDITIONS IN SUM AND DIFFERENCE CHANNELS OF MONOPULSE RADAR

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript 1 Apr 85) pp 10-12

[Article by M.G. Kalashnikov, S.G. Lukyanov and V.A. Melezhik]

[Abstract] The signal/noise ratio at the output of the linear part of the sum and difference channels of a radar is determined for different directions of arrival of the valid and interfering signals at the radar antenna in order to determine which of the channels provides the better conditions for detecting the valid signal in a particular electromagnetic situation. An amplitude sum-and-difference monopulse radar is examined in which each receiving channel is based on a matched filter for optimal reception of valid signals with random amplitude and initial phase. The gain in signal/noise ratio is tabulated as a function of the angular distance between the equisignal direction and the sources of the valid and interfering signals. The results show that the signal/noise ratio is greater in the difference channel than in the sum channel in most cases. Tables 1; references: 4 Russian.

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UDC 621.391

ESTIMATION OF COORDINATES OF COMPLEX OBJECT BY ITS IMAGE

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received 18 Mar 85 after revision) pp 12-15

[Article by A.P. Trifonov and V.B. Manelis]

[Abstract] The parameters of a complex image consisting of a number of non-overlapping fragments with the same form are estimated. Direct and indirect algorithms are derived and compared for an image whose fragments are located on two straight-line segments of the same length that intersect at a right angle. The direct position-fixing method is found to be significantly more accurate than the indirect method. The expressions derived make it possible to choose between the two methods depending upon available operator information, as well as the requirements for accuracy and ease of technical implementation. Figures 2; references 5: 4 Russian, 1 Western.

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METHOD FOR FORMING GAPS IN RADIATION PATTERN OF SCANNING PHASED ANTENNA ARRAY

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received 11 Mar 85) pp 57-59

[Article by S.B. Mikhaylenko]

[Abstract] An approximate method is proposed for forming gaps in the radiation pattern of a symmetrical phased antenna array in specified directions by controlling the phases of the elements in conformance with expressions describing the sought phase vector and the resulting phase vector. In the proposed method, additional phase shifts of the elements of the phased array for forming the gaps are added to the phase distribution that facilitates scanning of the main beam of the array. In addition to linear symmetrical arrays, the method can be extended to symmetrical flat arrays employing row-and-column control, as well as the use of some of the elements, arranged symmetrically with respect to the center of the array, to form gaps. The proposed method is found to be sufficiently effective, and makes it possible to scan the main beam of the array while forming gaps. Figures 2; references 4: 3 Russian, 1 Western.

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UDC 621.396.67:522.59

FORMATION OF MULTI-BEAM ANTENNA ARRAY PATTERN

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received after revision 18 Mar 85) pp 60-61

[Article by V.S. Artyukh and S.M. Kutuzov]

[Abstract] A technical method is investigated for forming a multi-beam antenna array pattern for radiotelescopes operating in the meter band. The proper angular distance between the beamssis determined with the help of the theorem of residues pertaining to the recovery of a function with a limited spectrum from its discrete samples. The proposed scheme employs a Butler phasing matrix, which makes it possible to form as many phase distributions as there are inputs (outputs) of the phasing matrix; a distance between beams can be achieved that is twice that required according to the theorem of residues. Because this matrix can produce two sets of phase distributions simultaneously, the signals from the individual parts of the antenna must be passed through directional couplers from the inputs and from the outputs of the matrix. A diagram of a Butler matrix incorporating directional couplers is shown. Figures 1; references 8: 6 Russian, 2 Western.

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MEASUREMENT OF CHARACTERISTICS OF PHASED ANTENNA ARRAYS BY SWITCHING METHOD

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received after revision 29 May 85) pp 62-64

[Article by S.M. Nikulin, Yu.N. Seryakov and S.A. Fursov]

[Abstract] A method is proposed for measuring the characteristics (radiation pattern and gain) of phased antenna arrays in which the phase inverters are switched when a signal is observed at the output of the stationary probe. The phased array is described by an approximate mathematical model that is adequate to the reflecting structure of the array. All of the radiation characteristics of the array are determined through the characteristics of its channels, allowing the measurement process to be separated into two stages: measurement of the channel directivity characteristics, and measuring the channel excitation characteristics. The measurement method is attractive in that it does not require cumbersome mechanical devices for moving the instrumentation probe, and makes it possible to take all measurements significantly more

rapidly than for other methods. The serviceability of each channel can be monitored, and the radiation characteristics of the array calculated, regardless of phasing. References 4: 3 Russian, 1 Western.

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UDC 621.396.674.1

ELECTRICAL PARAMETERS OF LOOP ANTENNA WITH OR WITHOUT FERRITE CORE CLOSE TO CONDUCTING SURFACE

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received 11 Mar 85 after revision) pp 64-67

[Article by A.F. Mikheyev]

[Abstract] The change in the inductance and effective length of a loop antenna with or without a ferrite core as it approaches a conducting surface is investigated. The analytical and experimental data for effective antenna length agree well; the effective length of a ferrite-core antenna close to a conducting surface is found to be approximately twice that in free space. As two loop antennas with ferrite cores are brought together, their inductance drops off due to mutual inductance, as well as depolarization of the cores. It is shown that placing a ferrite-core loop antenna at distances from conducting surfaces that are smaller than the core diameter causes a sharp drop in the effective length and inductance, so that such antennas should be placed at least one diameter of the ferrite core above a conducting surface. Figures 4; references: 3 Russian.

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UDC 621.396.67.537.874.6

METHOD FOR SOLVING PROBLEMS OF ELECTROMAGNETIC WAVE DIFFRACTION ON CYLINDRICAL SURFACE WITH INFINITE GENERATOR

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received 5 May 85) pp 67-70

[Article by Ye.V. Zakharov, Yu.V. Pimenov and A.V. Danilov]

[Abstract] A numerical method is proposed for solving the problem of diffraction of electromagnetic waves on a cylindrical surface with an infinite generator, for which the electromagnetic field cannot be assumed to be planar and for which the corresponding electrodynamic problem is a

three-dimensional vector problem. In the proposed method, the three-dimensional vector problem of electromagnetic wave diffraction on a cylindrical surface with infinite generator is reduced to two one-dimensional equations (integro-differential and integral) of the first kind with respect to the Fourier transform of the current density components induced on that surface. The structure of the resulting equations is similar to the structure of the equations for two-dimensional problems of diffraction on the same surface, permitting them to be solved in succession, which makes the numerical solution algorithm significantly more efficient. The influence of an ideally conducting strip on the directional properties of an elementary electrical dipole is analyzed as an example. Figures 3; references: 5 Russian.

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PLAN-POSITION INDICATOR SIMULATOR

Moscow RADIO in Russian No 8, Aug 85 pp 24-26

[Article by Yu. Voronov and V. Lobov]

[Abstract] An electronic antenna rotation simulator is described that forms two sawtooth voltages that are amplitude-modulated by sinusoidal and cosinusoidal voltages. The simulator incorporates a one-shot multivibrator, two integrators, and an audio oscillator, as well as a "north" marker generator consisting of a comparator, a limiter, and the marker circuit. The schematic diagram of the simulator, which incorporates K155 and K140 microcircuits, is shown. The alignment procedure is described step by step, and interfacing the simulator with a target simulator is described. Use of the plan-position indicator simulator for training radar operators has shown good operating reliability, small power consumption, and ease of adjustment.

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UDC 621.383:621.383.001.66

DETERMINATION OF TRANSFER CHARACTERISTICS OF SCANNING RADIOMETERS FOR RECORDING POINT SOURCES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 6 Dec 84) pp 6-8

[Article by A.V. Afonin]

[Abstract] A method is developed for efficient selection and estimation of the parameters of the transfer characteristic of the optical-electronic channel in a scanning radiometer designed for recording of the radiation of point sources. The study is made for the case most frequently encountered in practice, when the radiometer has a rectangular field of vision with uniform sensitivity. The results of analysis of estimates of the optimal transfer characteristics indicate that the fractional component of noise due to expansion of the field of vision in the scanning direction can be compensated by decreasing the pass band of the electronic channel with increasing measurement accuracy. When there is spatial variation in the background, the usual case, the method here developed allows a compromise solution to be found between the great influence of systematic error and random error, minimizing total measurement error. Figures 1; references: 5 Russian.

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CSO: 1860/98

UDC 621.396.96

EXTRAPOLATION AND MAJORITY ALGORITHM TO DETERMINE FREQUENCY OF ECHO SIGNALS FROM HYDROMETEORS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 8, Aug 85 (manuscript received 31 Jan 85) pp 8-12

[Article by N.V. Makarova and L.N. Prusova, Leningrad Institute of Aviation Instrument Building]

[Abstract] The processing device forms signals proportional to the difference of frequencies and feeds them to the majority circuit to select the minimum signal value, implemented in a microprocessor. Statistical properties of the signal at the output of a majority circuit for selection of the frequency of a reference oscillator signal corresponding to the frequency of an echo signal are analyzed. Microprocessor memory stores the coded frequencies of all available reference oscillators. The minimum signal can therefore be used to determine the frequency of the reference oscillator closest to the desired echo signal energy spectrum, which is

proportional to the speed of movement of hydrometeors. The mean square value of the central frequencyof the energy spectrum of the echo signal is calculated on a digital computer by means of the distribution density equation presented in this article. With normal distribution, the central frequency is determined by curves presented in the article. An extrapolation algorithm is presented for extrapolation of the echo signal frequency in accordance with the hypothesis set forth in the article concerning the nature of the model of the reflected signal. The estimate error covariation matrix is calculated using an equation presented, with the square of the central frequency accepted as an initial condition. Figures 2; references: 4 Russian.

6508/9835
CSO: 1860/63

HIGH-RESOLUTION TELEVISION

Moscow RADIO in Russian No 8, Aug 85 pp 17-18

[Article by B. Stepanov]

[Abstract] The high-resolution television system developed by Nippon Radio is discussed. The optimal number of vertical scanlines is determined subjectively to be 1125, with a preferable screen width-to-height ratio of 5:3. Although outstanding picture quality is provided, a 27 MHz bandwidth is needed to transmit high-resolution television. The use of signal compression to overcome this difficulty is described. Because high-resolution television is not compatible with standard television, implementation of the former will require the replacement of studio, transmitting, and receiving equipment. This, in conjunction with the increased bandwidth requirements, is a hindrance to the introduction of high-resolution broadcast television.

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MODERN SHORTWAVE TRANCEIVER

Moscow RADIO in Russian No 8, Aug 85 pp 19-21

[Article by V. Drozdov]

[Abstract] A shortwave transceiver for amateur use is described. A flexible variable-frequency oscillator is employed that provides good stability and low noise, allowing the transmitting and receiving circuits to employ switch-type high-level mixers. The IF and audio frequency circuits provide good receiving selectivity. The structural diagram of the transceiver is traced and explained. Figures 4.

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IMPROVEMENT OF 6MAS-4 LOUDSPEAKER

Moscow RADIO in Russian No 8, Aug 85 pp 29-30

[Article by M. Zhagirnovskiy and V. Shorov]

[Abstract] Improvment of the frequency response of 6MAS-4 stereo speakers is described. Poor sound quality is improved by eliminating a valley on the frequency response curve between 1,000 and 5,000 Hz. This is done by connecting the 10GD-34 low-and medium-frequency head through a first-order low-pass filter, and replacing the 3GD-31 high frequency head with a 1GD-50, which has more bandwidth. Modification of the speaker in this way eliminates the low-frequency valley on the frequency response curve and provides a boost in the 7,000-10,000 Hz region. Figures 3; references: 2 Russian.

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UDC 621.391.837:621.397.13

CHOOSING PARAMETERS OF HIGH DEFINITION HIGH QUALITY TELEVISION SYSTEMS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 85 pp 3-9

[Article by V.N. Bezrukov, A.V. Korolev, V.N. Lyapunov and O.S. Novakovskaya]

[Abstract] Special features of the choice of basic parameters of high definition, high quality television systems are examined. The size of the television receiver screen, the television image reproduction frequency and frame frequency, and the number of lines transmitted and reproduced are considered. The change in the relative visual perception energy is derived. as a function of the transmitted space and time frequency band. It is demonstrated that digital filtering must be employed at the transmitting and receiving ends of the television system in order to achieve optimal matching of the transmitted spectrum of time and space frequencies with the structure of the multidimensional frequency response of the human visual system. Figures 4; references 17: 7 Russian, 10 Western.

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UDC 771.77:543.062

DEVELOPMENT OF METHODS FOR QUANTITATIVE DETERMINATION OF COMPONENT CONTENT OF BLEACH-FIX SOLUTION

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 85 pp 10-13

[Article by Ye.L. Grigoreva, T.N. Oreshkina, A.P. Strelnikova and N.Ye. Shchukina]

[Abstract] Methods are described for quantitative determination of the component content in a bleach-fix solution for commercial motion-picture film processing. Determination of the content of thiourea, sodium carbonate, Fe-EDTA, sodium sulfite, and sodium thiosulfate in bleach-fixing solutions is described. The methods make possible quantitative determination of the content of the components in the solutions, permitting wider commercial use of the latter for film processing. A comparative assessment of the accuracy of methods for determining the content of components in bleach-fixing solutions is presented. Tables 1; references 6: 1 Russian, 5 Western.

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UDC 778.411+778.417

COMPARISON OF LENTICULAR PLATE AND MIRROR RASTER FORMATION OF THREE-DIMENSIONAL IMAGE

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 85 pp 14-16

[Article by N.K. Ignatyev]

[Abstract] A comparison is made between lenticular plate and mirror raster three-dimension picture formation. Certain common geometric principles associated with the behavior of the light beams that form the three-dimensional image are shared by both classes of systems. The similarity is especially strong in terms of forming a specified point of the reproduced three-dimensional image by the intersection of the emitted beams. Similarities are also noted in the causes of limited resolution and distortions that occur. Because the two methods are so similar, it is possible to combine, and therefore to simplify, investigation of the corresponding systems. Figures 3; references: 2 Russian.

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UDC 534.321+534.75

AUDIBILITY OF PHASE DISTORTIONS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 85 pp 17-22

[Article by Yu.A. Indlin]

[Abstract] Experimental findings are presented that indicate that the masking of one musical tone by another is accompanied by partial loss of loudness, as well as a change in the pitch of the masked tone, which is also phase-dependent. An experiment is described in which subjects were able to listen to a dual-tone complex or a pure comparison tone by moving a switch. The findings indicated that the frequency of the comparison tone as established by the subject depends strongly upon the initial phase of the masked tone. When one tone is masked by another, the pitch of the masked tone moves to the region of higher frequencies. The frequency shift depends upon the levels of the interacting tones, as well as the phase offset between them. The frequency shift phenomenon, and its connection with the parameters of the interacting tones, is explained from the viewpoint of spectral-time analysis. Figures 6; references 13: 11 Russian, 2 Western.

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UDC 791.44.022:628.94]-533.52+771.447-533.52

RO-60-2-2 and RO-120-4-3 LIGHTING CONTROLLERS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 85 pp 40-42

[Article by Yu.B. Anisimov]

[Abstract] Lighting controllers handling 60 and 120 circuits for movie and television studios developed by the Tallin Mechanical Motion Picture Equipment Plant are described. These controllers handle incandescent lamps rated at 220V and up to 10kW. RO-60-2-2 regulators controlling 48 5kVA and 12 10kVA circuits and 24 10kVA circuits is in operation in Sochi. The characteristics of the controllers permit their use in concert studios and large clubs; plans call for employing the controllers at several film studios now being modernized.

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UDC 771.537

DETERMINING KINEMATIC CHARACTERISTICS OF A MOVING OBJECT BY FRAME IMAGE PHOTOMETRY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 27 Feb 85) pp 1-3

[Article by Ye.G. Devoyno]

[Abstract] One shortcoming of known methods for determining kinematic characteristics of moving objects based on cinematography is that they allow determination not of the instantaneous values of coordinates, velocities and accelerations, but rather values averaged over the period of a frame. The methods suggested in this article allow determination of coordinates, velocity and acceleration at any moment during the exposure time by photometry of the image on one frame. The method distinguishes between basic unsharpness of the photographic system and the image shift caused by movement, and integrates the true movement shift to determine the desired parameters of movement for any moment during the exposure time. Expeirmental results confirm the accuracy of the method. Figures 4; references 8: 6 Russian, 2 Western.

6508/9835
CSO: 1860/98

UDC 621.384.3

USE OF PULSE-MODE LIGHT-EMITTING DIODES IN TELEVISION SETS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 13 Jul 84) pp 45-47

[Article by A.M. Shirobokov and A.N. Kolyanov]

[Abstract] Light-emitting diodes (LED) can be used as sources of modulated light to improve the characteristics of television devices. Multiple-element IR radiation receivers must be functionally connected to multiple-element LED lines, either by the use of a multiple-element amplifier, or by using a single amplifier and switch. Without discussing the advantages and disadvantages of the two possibilities, their specifics are described as related to the concept of effective image brightness. The use of rows of LED based on GaAsP can in some cases allow the designer to eliminate signal recording circuits when working in the switched mode. Figures 2; references: 4 Russian.

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UDC 621.37

SYNTHESIS OF KALMAN FILTER EMPLOYING TRACKING SENSORS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 pp 19-20

[Article by V.I. Merkulov]

[Abstract] A method is proposed for synthesizing a Kalman filter that takes into account the inertia of the tracking sensors and the correlation of their output noise without expansion of the initial state vector. A filter is synthesized for estimating the distance between two moving objects, their mutual rate of approach, and relative acceleration assuming that the range finder employs a tracking radar range finder with one indicator. The proposed algorithm provides a gain in dimensionality (number of equations to be solved) over the commonly used method in which the initial state vector is expanded.

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UDC 621.397.57

SYNTHESIS OF QUASIOPTIMAL NONRECURSIVE DIGITAL FILTERS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received 20 Nov 84) pp 26-30

[Article by B.D. Matyushkin and A.Yu. Vinogradov]

[Abstract] A method is proposed for synthesizing quasioptimal nonrecursive digital filters that requires fewer multiplications than Chebyshev nonrecursive digital filters. The synthesis method is based on applying linear interpolation to the samples of the impulse response of an auxiliary Chebyshev nonrecursive digital filter. An algorithm for synthesizing quasioptimal nonrecursive low-pass filter is presented. The synthesis method can be employed by developers of digital signal processors in designing narrowband low-pass nonrecursive digital filters for various applications. Figures 3; tables 1; references 5: 2 Russian, 3 Western.

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DETERMINATION OF EXPONENT OF SPECTRAL NOISE FUNCTION

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received 14 Feb 85 after revision) pp 46-48

[Article by S.A. Vikulin and V.A. Kuzmin]

[Abstract] This study addresses the estimation of the exponent n of the function $G(f)=G_0/f^{2n}$ describing the power spectrum of certain noise processes, where G_0 is the spectrum power referred to some reference frequency, and f is the current frequency. A device that calculates the exponent of the spectral function is presented. It is found that unbiased estimates will be obtained for the exponent of the spectral function of a noise signal if the analyzing filters have similar center-frequency characteristics. The bias of the estimate of the power spectrum, referred to the reference frequency, depends upon the exponent of the spectral function, and can be taken into account when the frequency responses of the filters are known. The degree of filtering (suppression) of the low-frequency and high-frequency regions of the signal is determined by the range of the exponent n and the acceptable amount of bias of the spectral density estimates. Figures 2; references 8: 6 Russian, 2 Western.

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UDC 543.42:621.3.019.3

INCREASING ACCURACY OF SPECTRAL ANALYSIS OF CORRELATION PROCESSING OF A SIGNAL

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 6 Jun 85 (manuscript received 11 Oct 84) pp 6-8

[Article by V.P. Kontorovich, Tolyatti Polytechnical Institute]

[Abstract] In order to achieve satisfactory accuracy and speed of spectral analysis of complex signals, a spectral analyzer with a limited number of wide band filters with subsequent sharpening of the amplitude-frequency characteristic by special processing of the signals at the output of the filters is suggested. This processing includes time analysis of the signals over the period of one of the frequencies of the pass band of one filter, perhaps the center filter; discretization of the signals; successive multiplication of samples in pairs; and weighted averaging. The structure suggested allows achievement of good resolution due to the operations of sharpening the amplitude-frequency characteristic of the conversion channels, which perform square-law detection and averaging. Computer modeling

indicates that the error of spectral analysis for wide band signals will be 1-5%. References: 8 Russian.

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UDC: 519.688:535.317.7

ACCELERATED MODIFICATION OF KOTELNIKOV FAST INTERPOLATION ALGORITHM

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 28, No 6, Jun 85 (manuscript received 20 May 83) pp 37-39

[Article by I.P. Agurok and V.Ye. Zaxarin, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] A previous work suggested an algorithm for rapid interpolation of a Kotelnikov function with finite spectrum based on 2N samples. In this work the area of approximation of the composition function used is expanded, allowing a decrease in the number of recomputations required by the algorithm in restoring F_N in several zones of interpolation and an increase in speed of the algorithm. The number of approximation coefficients is found to increase more slowly than the zone expansion coefficient, leading to additional increases in speed. References: 2 Russian.

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CSO: 1860/34

UDC: 621.317.08

STUDY OF OPTIMAL AND SUBOPTIMAL ALGORITHMS FOR ESTIMATING ONE EGG PARAMETER WITH NOISE PRESENT

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 28, No 6, Jun 85 (manuscript received 4 May 84) pp 66-71

[Article by Yu.S. Radchenko and D.A. Presnyakov]

[Abstract] One problem with microprocessor-band electrocardiogram-analysis algorithms is their deterministic nature, preventing effective operation when fluctuation noise, such as muscle noise, is present. Optimal and suboptimal algorithms for estimating the pulse repetition period in a noisy electrocardiogram are studied. The suboptimal algorithm was implemented on an Elektronika-60M microcomputer system, with one computer formulating a noisy pulse sequence imitating the ECG, and another running the estimation program. Figures 2; references: 2 Russian.

6508/9835
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UDC 621.372.632

HIGH-SPEED ACTIVE WIDEBAND PHASE KEYERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 10, Oct 85 (manuscript received, after revision 30 Apr 85) pp 91-93

[Article by V.G. Batura, R.V. Kiselev, N.N. Lelyukh, A.A. Lipatov and A.V. Sukhanov]

[Abstract] Phase keying with amplification is done much faster and more efficiently by a device consisting of a pair of GaAs field-effect tetrodes and a pair of quadrature bridges with matching circuits than by a pair of PIN diodes of Schottky-barrier diodes, namely at Gbit/s speeds without appreciable charge dissipation. Such devices can be built by either monolithic or hybrid-integrated technology. The analog input signal passes through the first bridge to the first pair of gates, and the modulating digital signal, two opposing sequences of bipolar pulses, passes to the second pair of gates. The theoretically calculated performance characteristics, namely complex transmission coefficients and dynamic pulse spectrum, agree closely with the measured ones. Measurements were made by applying meander test signals to the second gates of experimental phase keyers built with 3P328A-2 field-effect Schottky-gate tetrodes and Lange bridges. With the aid of these data, phase keyers can be designed for specified limits on energy losses, phase deviation, and parasitic amplitude modulation. Figures 3; references: 4 Russian.

2415/9835
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UDC 621.391.1

EFFICIENCY OF QUASI-OPTIMUM PROCESSING OF COMPOUND SIGNAL APPEARING WITH STRONG NONGAUSSIAN INTERFERENCE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received, after revision 28 Jan 85) pp 30-33

[Article by V.V. Avdeyev and Yu.N. Parshin]

[Abstract] A quasi-optimum algorithm is considered for processing a compound signal of independently adjustable duration and spectral width which appears together with white noise and a strong nongaussian interference. Such a signal constitutes a segment of a harmonic oscillation, phase modulated by a binary random code; and a nonlinear compensator is most suitable for compensation of nongaussian interference, inasmuch as its accuracy of interference estimation improves with increasing interference-to-noise ratio. The efficiency of this algorithm according to the criterion of maximum output signal-to-interference ratio is estimated by a method of analyzing correlational signal distortions, with the first variation of the random phase determined from the equation describing its first time derivative. Numerical calculations for $\alpha T>>1$ (α- width of phase fluctuation spectrum, T- signal period) reveal an anomalous behavior of the signal-to-interference ratio, namely its saturation as the phase dispersion exceeds 0.5, attributable to conversion of the useful signal by a nonlinear compensator with attendant appearance of signal distortion consisting of a deterministic component and a stochastic one. Figures 1; references: 5 Russian.

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UDC 621.391.3

INTERPOLATION OF NARROW-BAND SIGNALS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received, after revision, 4 Dec 84) pp 60-65

[Article by V.I. Boyevkin and A.V. Zhogal']

[Abstract] Interpolation by polynomials is considered for reproduction of narrow-band signals, according to a procedure analogous to interpolation of wideband signals. A first-degree polynomial, for instance, replaces the readout function and becomes a "modulated" reproudcing function. Addition of a harmonic multiplier as "carrier" to the given interpolating function makes it then possible to select the discretization frequency with

a resulting advantage equal to the ratio of upper cutoff frequency to frequency deviation. There are two criteria for fideltiy of such a reproduction with in a given discretization period, namely a point criterion such as the instantaneous mean-square error and an integral criterion such as the average mean-square error over a discretization period. Along with or instead of modulated polynomials, not necessarily of the first degree, one can also use modulated splines for reproduction of narrow-band signals. A cubic spline, particularly, combines excellent approximation characteristics with simplicity of the algorithm. In a typical numerical example, according to calculations on a YeS-1022 computer, an $S_{3/2}$-spline is approximately 23% more accurate than a third-degree polynomial but 2-5% less accurate than an $S_{5/3}$-spline. The interpolation method is also applicable to narrow-band random signals. Figures 2; references 6: 4 Russian, 2 Western (in Russian translation).

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UDC 621.372.54.037.372:621.391.2

MODULUS METHODS OF ESTIMATING READOUT AMPLITUDES FOR DISCRETE FOURIER TRANSFORMATION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received 11 Sep 84) pp 66-70

[Article by G.P. Afonenko, S.N. Britin and A.T. Trofimov]

[Abstract] Simplified calculation of the amplitude spectrum for discrete Fourier transformation is shown, by operations on the moduli of complex numbers $Z_0=\sqrt{z_1^2 + z_2^2}$. Algorithms of the class $Z^* = \max\{|z_1|+k|z_2|, k|z_1|+|z_2|\}$ are selected, where Z^* denotes the estimated amplitude of a spectral component, on account of their easy technical implementation and sufficiently high accuracy. The effectiveness of such a procedure is analyzed by geometrical treatment in the complex plane. Although the algorithms $Z^*=\max\{|z_1|,|z_2|\}$ ($k=k_1=0$) and $Z^*=\{|z_1|+|z_2|\}$ ($k=k_2=1$) are least accurate, they are the simplest ones and most expedient for implementation on a computer with an arithmetic unit which can handle word lengths of 8-10 binary digits. As the word length capacity of the arithmetic unit increases, more intricate but also more accurate algorithms with $k=k_3,k_4,\ldots$ become preferable. Figures 2; tables 1; references 6: 4 Russian, 2 Western (1 in Russian translation).

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CSO: 1860/86

UDC 621.317.341

LOCALIZATION OF INHOMOGENEITIES IN RADIO CHANNELS BY SYNTHESIS OF SIGNALS IN TIME DOMAIN FROM PHASE-FREQUENCY CHARACTERISTICS OF REFLECTION COEFFICIENTS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 9, Sep 85 (manuscript received, after revision, 2 Jul 84)
pp 78-80

[Article by Ye.L. Bartashevskiy, V.S. Varyvdin and O.O. Drobakhin]

[Abstract] Localization of inhomogeneities in radio transmission lines, feeders, and multilayer materials is possible by measurement of the phase-frequency characteristic as well as the amplitude-frequency characteristic of the complex reflection coefficient and subsequent synthesis of signals in the time domain from those readings. Measurements can, accordingly, be made over a wide frequency range with the use of oscillators tunable over adjacent subranges. Appplication of this method is demonstrated on the complex reflection coefficient of a double-layer structure with each layer of a different thickness having a different complex dielectric permittivity and the complex reflection coefficient of the shorting bar assumed to be 95%, also on the reflection coefficient of a shorted coaxial feeder with a ferrite disk. Experiments were performed within the 4-12 GHz frequency range and pulses of duration of the order of 250 ns were synthesized. With special instruments it is possible to make measurements over the 0.01-12 GHz frequency range and to synthesize the envelope not only of a radio pulse but also of a video pulse with durations of the order of 80 ns. Figures 2; references 4: 1 Russian, 3 Western (1 in Russian translation).

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IDENTIFICATION OF NOISE SPECTRUM ON BASIS OF MAXIMUM-LIKELIHOOD CRITERION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 9, Sep 85 (manuscript received, after revision, 23 Jan 85)
pp 80-82

[Article by Yu.L. Mazor and V.M. Petrenko]

[Abstract] The problem of identifying a noise spectrum, for synthesis of quasi-optimum adaptive receivers, is treated as a special case of multi-alternative detection. Accordingly, statistical hypotheses are tested for correspondence of a given noise process to any of all spectrum forms in a given class. In the distribution function of the indicators vector there appear here the a priori unknown average noise power and the discrete number in the set of natural numbers uniquely assigned to the various spectrum forms.

An algorithm of identification is constructed on the basis of the maximum-likelihood criterion. Results of statistical simulation on a YeS computer indicate that this algorithm, as well as its approximation based on the criterion of maximum signal-to-noise ratio, is invariant with respect to the average noise power. They are almost equally efficient when the averaging parameter varies over a wide range, the approximate algorithm being more efficient when the averaging parameter remains much smaller than unity. The algorithm based on the criterion of minimum mean-square error is least efficient of all and, moreover, not invariant with respect to the average noise power. Tables 1; references 3: 1 Russian, 2 Western (in Russian translation).

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SEQUENTIAL ALGORITHM OF SIGNAL DETECTION WITH SYMMETRIC GROUPING OF CHANNELS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received, after revision, 17 Dec 84) pp 82-84

[Article by V.P. Bezguzikov]

[Abstract] A nonparametric and therefore stable algorithm is constructed for detection of signals with a priori indeterminancy. This algorithm is a sequential one, based on comparing asignals in adjacent channels and ranking the channels: rank +1 assigned to the channel with the maximum signal level and rank -1 assigned to all other channels. The hypothesis about presence of a signal is accepted or rejected depending on the sum of ranks for each channel. The maximum signal is selected from a group of m channels, this number m being determined from the criterion of symmetric quantization. Symmetric quantization implies that the probability of any channel having the rank +1 in presence of a signal is equal to the probability of its having the rank -1 in absence of a signal. The validity of this detection method is demonstrated, in accordance with the theory of random walk, on detection of a noncoherent signal reflected by a fluctuating target and mixed with normal clutter. Figures 1; references 5: 4 Russian, 1 Western (in Russian translation).

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UDC 621.314.26(0.88)

DEPENDENCE OF DEGREE OF SUPPRESSION OF HIGHER HARMONICS ON DEGREE OF ASYMMETRY OF QUASI-SINUSOIDAL SIGNAL

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript receive 18 Jul 84) pp 95-96

[Article by V.V. Vasyukov and V.S. Klimov]

[Abstract] Synthesis of a step-wave signal with the use of Walsh functions is considered, such a synthesis being optimum with respect to the main criteria: ripple factor and high order of the lowest harmonic in the signal spectrum. The principle is demonstrated on an A_1-A_2-A_1 two-step signal without harmonica of orders $8k\pm3$ ($k = 0,1,2,...$): low level A_1 from 0 to $\frac{1}{4}\pi$, first step up to $A_z = (1 + \sqrt{2})A_1$ at $\frac{1}{4}\pi$ to $\frac{3}{4}\pi$, second step down to low level A_1 at $\frac{3}{4}\pi$, low level A_1 from $\frac{3}{4}\pi$ to π. Following a Fourier series expansion of a real signal, the ratio A_2/A_1 is determined which will minimize the ratio A_{2k-1}/A_1 for those ideally missing harmonics. This ratio is found to be 1 + /2. Figures 2; references: 3 Russian.

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UDC 621.391.278

MULTICRITERIAL SELECTION OF OPTIMAL COMPLEX SIGNAL AND PROCESSING DEVICES FOR ASYNCHRONOUS DATA TRANSMISSION SYSTEMS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 pp 51-55

[Article by N.I. Smirnov]

[Abstract] The use of multicriterial discrete selection in choosing the type of complex signals and corresponding structural diagrams for asynchronous data transmission systems employing a satellite transponder is described. A matrix of the correspondence coefficients for all of the performance indicators is constructed in accordance with different versions of the fast complex signal acquisition device. The priority of the optimal complex signal is estimated quantitatively in comparison with the other complex signals, and the feasible probability of use of all types of complex signals is identified. It is found that the feasible probability of use of two types of composite sequences--composite PSK complex signals with frequency jumps--is four times higher than for single-frequency PSK signals. Figures 2; tables 4; references 6: 4 Russian, 2 Western.

6900/9835
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UDC 621.391.823:62-758.38

ASSESSMENT OF EFFECTIVENESS OF ELECTROMAGNETIC SCREENS FOR WORK SPACES

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received after revision 11 Mar 85) pp 73-75

[Article by A.P. Yefimov]

[Abstract] A new method is proposed for assessing the effectiveness of electromagnetic screens for work spaces. Rather than calculating the field intensity within the screen, the combined power of the electromagnetic energy penetrating the screen is determined. The proposed method is found to be simpler than other methods now in use; comparison of the analytical results with measurement results shows that the proposed method allows the order of the effectiveness of screening to be estimated correctly. Figures 4; references 10: 9 Russian, 1 Western.

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UDC 62.501.1

FAST FOURIER TRANSFORM ALGORITHM IN TRIANGULAR-SYMMETRICAL FUNCTION BASIS

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 7, No 5, Sep-Oct 85 (manuscript received after revision 26 Mar 85) pp 11-13, 35

[Article by A.Ya. Beletskiy, A.I. Davletyants, A.A. Semenov and R.B. Sinitsyn]

[Abstract] A study is made of the construction of algorithms for spectral analysis, utilizing expansion of signals based on a system of conjugate orthogonal triangualr-symmetrical functions (TCF) over a normalized sector of a variable. The major properties of the basis system of functions are presented: the system of functions are functions of equivalent variabless and any inclusions relative to one of the variables are correct for the other, meaning that the matrix of transforms in the basis is symmetrical; the system of orthogonal functions is complete; since the basis contains the functions and their product, the system of orthogonal functions is multiplicative. There are only $L = 2^{m-2}$ ($m = \log_2 N$) nonzero absolute values of the real and imaginary parts of the phase multipliers, indicating that the operation of complex multiplication can be reduced to simple shift and addition operations, increasing speed of analysis. The effectiveness of spectral analysis in the TCF basis is comparable to the effectiveness of spectral analysis in a DEF basis, making it particularly suitable for use over small signal definition intervals, with small sample volumes. Figures 3; references 8: 7 Russian, 1 Western.

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CSO: 1860/70

UDC 681.84.087.47

LINEAR DISTORTIONS OF AUDIO SIGNALS IN DIGITAL BAND-PROCESSING DEVICES

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 9, Sep 85 pp 9-15

[Article by Yu.V. Berendyukov, Yu.A. Kovalgin and M.A. Sergeyev, Leningrad Institute of Electrical Communications Engineering imeni M.A. Bonch-Bruyevich]

[Abstract] Digital band processing is considered for implementation in digital sound transmission systems. First the spectrum of the audio input signal is partitioned by a filter array into frequency bands, whereupon all the narrow-band partial signals are individually encoded for transmission and storage. On the receiver side they are again individually decoded and in original analog form combined by a summator into a wideband audio output signal. In the simplest coding system a speech signal is split into only two parts, a high-frequency one and a low-frequency one, each being most effectively encoded by the method of adaptive differential pulse-code modulation. The same method can be used in the more intricate but also more precise 5-band system. The major problem with band encoding is filtration, unavoidable nonlinearity of band filters and jumpwise changes in the group delay time with attendant interference of partial signals at the corners causing local distortions of the frequency characteristics of the compound transmission channel. Most critical to the performance are linear distortions of the amplitude-frequency characteristic and these, therefore, need to be evaluated most thoroughly for purposes of adequate correction. A theoretical analysis of the basic band processing system, namely 2-band encoding and transmission demonstrates the principle. Such a system is considered for a stereophonic signal pair, a system which covers the 30-15000 Hz frequency range and includes two sum-difference converters with a low-pass filter in the S = A-B difference channel and without any modifier in the M = A+B sum channel. A breadboard model was assembled with standard components and with special devices, as required, built in the Radio Broadcasting and Acoustics Laboratory at the Leningrad Institute of Electrical Communications Engineering. A gamut of sound effects was monitored with Orbita-RV analog-digital recording equipment and bya statistically designed group of sound-and-hearing experts. Instrument readings indicated an approximately 700 Hz wide interference zone and irregularities of the amplitude-frequency characteristic not larger than 1.5 dB. The imperceptibility of these distortions by the human ear, according to the group of experts, confirms the viability of band encoding and transmission as an effective and competitive method of sound processing in digital audio systems. Figures 7; references 13: 3 Russian, 10 Western (4 in Russian translation).

2415/9835
CSO: 1860/83

COMMUNICATION OVER OPTICAL CABLES - ONE OF MAIN TRENDS IN SCIENTIFIC AND TECHNICAL PROGRESS

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 pp 1-2

[Article by Yu.B. Zubarev]

[Abstract] Optical cables together with integrated optical devices for data processing constitute a major recent development in communication technology, with a wide range of applications in television as well as in radio and in videotelephony. The main advantages of optical cables are their large bandwidth and high channel capacity, high interference immunity and low attenuation coefficient, adaptability to diverse data formats, small dimensions and small weight. To this must be added nonflammability and the economic effect of replacing scarce metals, namely copper and lead. The basic material of optical cables is quartz, a universally abundant one. The main problem with introduction of optical cables is, therefore, devising and refining the technological base for production of quartz glass and then a cable having the required physico-mechanical and optical parameters as well as performance characteristics in accordance with CCITT specifications. In the USSR, also in the CSSR and in the GDR, optical cables and especially cables with single-mode fibers are designed for an used in digital data transmission systems. While the operating wavelength is now generally within the 0.85-0.9 μm band, the trend is toward operation at wavelengths within the 1.3-1.55 μm band and eventually in the 2-6 μm range of infrared light, with an attendant decrease of attenuation to within the 0.2-0.5 dB/km level and corresponding increase of the allowable distance between successive repeater points to 50-100 km. Progress in the area of optical cables, as well as in theoretical and practical research dealing with communication optoelectronics must be credited to the various institutes at the USSR Academy of Sciences under V.A. Kotelnikov and A.M. Prokhorov, to the electrical engineering industry under V.F. Suchkov, V.P. Inozemtsov, A.M. Yeremenko, also the Moscow Institute of Power Engineering, and specialists at the USSR Ministries of Communications and Communication Equipment Industry. An important factor in implementing this progress is adaptation of governing GOST All-Union State Standards to fiber-optic terminology. Until this task has been completed, some leeway must be allowed in the definition and characterization of various concepts.

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FIBER-OPTIC DIGITAL TRANSMISSION SYSTEM FOR URBAN TELEPHONE NETWORKS

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 1 Jul 85) pp 3-7

[Article by A.A. Alikin, O.I. Gorbunov, V.T. Khrykin and B.Kh. Shklyar]

[Abstract] A first-generation fiber-optic digital transmission line is being installed between automatic exchanges in urban telephone networks, after successful pilot operation of an experimental such line for several years. The equipment for this line has been built according to CCITT specifications G.651, G.703, G.914 and is designed to operate in the 0.85 μm waveband with repeater points spaced 8 km apart. It is also capable of operating in the 1.3 μm waveband, when matched to the appropriate set of radiator on the input side and photodetector on the output side. The line has 120 tone-frequency channels formed by bidirectional coaxial pairs of graded-index fibers having a capacity of 8.448 Mbit/s in each direction when operating with IKM-120 pulse-code-modulation equipment, but also adaptable to other channel forming equipment. It transmits, after conversion into CMI code, square pulses of nominal ±2.37 V amplitude and 59 ns duration. In addition to converting and cable interfacing equipment, the line includes also service monitoring over an optical cable as well as over an electrica (copper) cable along with fault indication and location equipment for maintenance and repair. Figures 5; tables 1; references: 3 Russian.

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RELATIONS FOR DESIGN AND PERFORMANCE ANALYSIS OF MULTIMODE FIBER-OPTIC LIGHT GUIDES IN COMMUNICATION SYSTEMS

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 24 Apr 85) pp 7-9

[Article by A.S. Belanov and Ye.M. Dianov]

[Abstract] Two basic parameters which characterize multimode fiber optics, namely critical total-reflection angle and maximum intermode dispersion, are defined generally as functions of the numerical aperture and the two refractive indexes involved (core and sheath materials respectively). They are then redefined specifically for graded-index fiber optics with power-law index profiles. The relations derived accordingly for excitation losses, losses at junctions and losses at bends indicate the design constraints and the performance limitations. References 9: 3 Russian, 6 Western (1 in Russian translation).

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DISPERSION IN TWISTED SINGLE-MODE FIBER-OPTIC CABLES

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 18 Mar 85) pp 12-15

[Article by I.I. Grodnev and T.A. Tvoremirova]

[Abstract] Circular birefringence in optical fibers is considered in preference to linear birefringence, from the standpoint of ensuring propagation of only one mode and suppression of the other mode orthogonal to it, some birefringence being unavoidable in real fibers because of different phase velocities of orthogonally polarized waves or pulses in inevitably irregular structures. Circular birefringence can be produced by twisting the fiber, which results in a constant and thus more easily controllable difference of phase velocities. It is also technologically more expendent than minimizing linear birefringence in a straight fiber by avoidance of dimensional irregularities through tight tolerancing and control. The pulse widening in an optical cable with twisted but irregular core is caused by modal dispersion and chromatic dispersion. Modal dispersion arises from bending of fibers within the core as well as from ellipticity of the core and anisotropy of transverse tension, that anisotropy resulting from unequal thermal expansion of core material and sheath material. Assuming that chromatic dispersion is not appreciably sensitive to fiber twisting, it can be regarded as consisting of a material component and a waveguide component. Analytical relations obtained in the approximation of additive modal and chromatic dispersions have been used for design and performance analysis of optical cables with SiO_2 and with SiO_2 + (4.1-13.5)% GeO_2 as core materials. The numerical data indicate that twist of fibers reduces modal dispersion appreciably, but only within some optimum range of other parameters for any given wavelength. With a 5-10 cm pitch of fiber twist, it appears feasible to reduce the pulse widening to 2-6 ps/km at the λ = 1.3 μm wavelength and to 4.5-6 ps/km at the λ = 1.55 μm wavelength. Figures 6; tables 1; references 5: 3 Russian, 2 Western.

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WELDER SET FOR SPLICING MULTIMODE FIBER-OPTIC LIGHT GUIDES

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 7 Jun 85) pp 16-17

[Article by L.P. Ploshay, V.P. Filimonov, V.G. Chertov, V.F. Davidenko, V.L. Kolpashchikov and G.S. Kuchinskiy]

[Abstract] A welder set has been developed jointly by the Institute of Heat and Mass Transfer (BSSR Academy of Sciences) and the Central Scientific Research Institute of Communications for splicing together multimode fiber-optic light guides. The technological process includes removal of the protective coating and separation of about 15 mm long bare end segments, then placement of each fiber in a different groove with the bare segment laid in a quartz crib and the rest with protective coating on laid in a metal crib. The fibers are constrained laterally by turn of the handle on a clamp, with their bare end segments monitored under a microscope for coaxial alignment in two orthogonal planes and then moved forward or backward by means of micrometer screws for splicing. The equipment, welding tool and electronic control module, can operate either with a manually programmed switch or automatically. An electric arc is produced across a 1.2-1.5 mm wide gap between two tungsten electrodes carrying a current of 20 mA. The equipment was tested in experimental splicing of grade-index and stepped-index fibers with sheath and core diameters 150/60 μm and 125/50 μm respectively, 2-2.5 diameters long fiber and segments being heated for this operation. The optimum arc duration is 3 s and a splice can be made which attenuates transmitted energy by less than 0.3 dB. Figures 1.

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PERFORMANCE ANALYSIS OF CABLE LINE BUILT WITH SINGLE-MODE OR LOW-MULTIMODE FIBER OPTICS

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 7 Feb 85) pp 21-26

[Article T.A. Martynova]

[Abstract] First a stepped-index fiber-optic cable is considered which transmits a single mode or a few modes from a coherent radiation source emitting a polarized spherical wave with given center frequency and with amplitude modulation by pulse code. Assuming negligible attenuation and distortion of the input signal $p_{in}(t)$ on the way from source to cable and along the cable, the output signal $p_{out}(t)$ is calculated for given source

parameters, given source-cable configuration including the distance between them, and given cable geometry as well as physical characteristics. This problem of cable performance analysis is solved on the basis of a general theorem pertaining to optical channels and stating that the output signal is determined by the frequency characteristic of the channel. Considering that the amplitude spectrum of a δ-pulse is uniform, the frequency characteristic of a stepped-index fiber-optic cable is calculated accordingly for a δ-pulse input signal. Numerical results for ideal fibers as well as for real fibers consisting of SiO_2 + GeO_2 core and SiO_2 + B_2O_3 sheath, or SiO_2 + GeO_2 core and SiO_2 sheath, or SiO_2 core and SiO_2 + B_2O_3 sheath at the three standard wavelengths λ = 1.3, 1.4, 1.55 μm indicate that the bandwidth of low-multimode fibers ranges from 10 to over 1000 GHz·km and that enhancement of transmission from a single mode N = 1 to N = 10-12 modes by an increase of the core radius will narrow down the passband on the average by at least one order of magnitude. Figures 5; references 10: 5 Russian, 5 Western (1 in Russian translation).

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RESULTS OF LIFE TESTS PERFORMED ON OPTICAL CABLES

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 3 Dec 84) pp 29-31

[Article by V.Ye. Vasilyev, O.V. Bondarenko, Yu.T. Larin and V.G. Nikolayev]

[Abstract] Optical cables of five different constructions, designed for underground communication lines, were tested over a period of one year, the purpose being to correlate cable reliability and life with the dependence of the attenuation coefficient on two basic environmental factors: temperature and moistness of the soil at the cable embedment depth. Another purpose was a comparative evaluation of those different cables in terms of sensitivity to the climatic cycle. Cables of designs I and II are characterized by a free lay of a single fiber and a pair of fibers, respectively, inside a protective sheath consisting of a teflon inner layer and a PVC pulp outer layer; cables of design III feature a single fiber wrapped in a layer of reinforcing glass filaments and the latter covered with a protective layer of PVC pulp; cables of design IV feature two pairs of fibers with profiled core of PVC pulp and reinforcing teflon filaments, all wrapped in reinforcing teflon tape with a protective layer of PVC pulp around; cables of design V feature two pairs of fibers of construction III twisted into a quad with reinforcing steel wires and then wrapped in reinforcing teflon tape with a protective layer of PVC pulp around. The cables were embedded 80-100 cm deep under the ground surface so as to avoid damage by rodents. For an analysis of the test data, the

year was subdivided into its 12 months as separate intervals in terms of mean temperature and moistness. On the overall basis, a composite of all performance indicators, design V was found to be the best and design II was found to be the worst. Figures 5; tables 1; references: 1 Russian.

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CONFERENCE ON RADIOOPTICS

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 p 31

[Article by I. Krylova]

[Abstract] An All-Union scientific and technical conference on "Problems in Development of Radiooptics" was held in June 1985 in Tbilisi, organized by both Central and Georgian executive boards of the Scientific and Technical Radio Engineering, Electronics and Communications Society imeni A.S. Popov jointly with the Institute of Cybernetics at the GSSR Academy of Sciences, the USSR Academy of Sciences, and the USSR Ministries of Radio Industry, Electronic Industry, Communications, Communication Equipment Industry, Higher and Secondary Special Education. About 200 specialists in the field participated in the presentation and discussion of 175 reports during several plenary and four section meeting. The major topics were: physical principles of optical memory, radiooptic memory systems, principles of optoelectronics, and optoelectronic devices. The conference on this new field of science and engineering revealed the possibility of producing an entire new generation of equipment for large-scale data recording, processing and display. The participants were made aware of the need for development of high-precision optomechanical devices and microprocessor-base control systems, for higher quality, stability, and reliability of transparencies, for actually producing the necessary assortment of hypothetically high-performance materials, for producing mechanical devices optimum with respect to basic optical parameters, and for instruments designed to measure laser radiation characteristics. The proceedings were very informative and well organized.

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FIBER-OPTIC COMMUNICATION SYSTEMS OPERATING AT 0.8-0.9 μm WAVELENGTHS; SURVEY OF FOREIGN LITERATURE

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 24 Aug 84) pp 32-37

[Article by Yu.B. Zubarev and B.N. Fedorov]

[Abstract] Foreign literature published during the 1970-82 period on the subject of fiber-optic communication systems operating at 0.8-0.9 μm wavelengths covers fiber materials and their performance characteristics (minimum attenuation having been attained with cores made of $SiO_2 + P_2O_5 + GeO_2$), radiation sources (GaAs light-emitting photodiodes and junction lasers with double heterostructure and strip line geometry being most efficient and reliable), and photodetectors (Si avalanche diodes offering a high gain at acceptable noise levels, but requiring a high bias voltage, while p-i-n diodes with somewhat worse characteristics require much lower voltages and offer a cost advantage). The surveyed foreign literature on this subject covers also CCITT specificaitons, field tests, installation and operation, as well as the economics of such communication systems using predominantly graded-index fiber optics for the 0.8-0.9 μm waveband, also the outlook for future developments in this already quite mature field and new applications such as in expanding urban telephone networks. Figures 6; references: 32 Western.

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FIBER-OPTIC DATA TRANSMISSION SYSTEMS OPERATING AT 1.3 μm AND 1.5 μm WAVELENGTHS: SURVEY OF FOREIGN LITERATURE

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 10 Jun 85) pp 38-40

[Article by V.I. Smirnov]

[Abstract] Foreign literature published in 1984 on the subject of fiber-optic data transmission system operating at λ = 1.3 μm or 1.5 μm wavelength covers transmission primarily of digital signals but also of analog signals over single-mode fiber optics, the performance characteristics of such lines and methods of operation as well as technologies involved in their installation. Interesting developments in these areas are fiber splicing on a drum, digital modulation of radiation from an INGaAsP-laser, high-speed 4-input/1-output modulation of an injection laser, terminal equipment with monolithic circuit integration, use of GaAs light-emitting

diode as source and Ge avalanche photodiode as receiver, spectral composition and separation of signals, and underwater cables such as the 80 km cable (France) and the 1000 km cable (Japan). The main trends in further developments abroad appear to be toward higher transmission rates in the 1-4 Gbit/s range, longer distances between successive repeater points, higher reliability of digital data transmission, and equipment for underwater fiber-optic communication systems. Tables 1; references: 12 Western.

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LOW-FREQUENCY INTERSYMBOL DISTORTIONS OF DIGITAL SIGNAL IN REPEATERS WITH QUANTIZED FEEDBACK

Moscow ELEKTROSVYAZ in Russian No 10, Oct 85 (manuscript received 27 Jan 83) pp 48-52

[Article by V.A. Rubtsov]

[Abstract] Low-frequency distortions of digital signals in high-speed data transmission systems can be compensated by means of quantized feedback in the repeater circuits, which eliminates the need for special balanced codes and facilitates transmission of plain binary and multilevel signals with small or no excess. The performance of such a repeater is analyzed in relation to its structure, which consists of the amplifier and an additional filter before the resolver with a low-pass filter in the feedback loop around the latter. A delay line in the forward channel is included for compensation of the time delay in the resolver. The maximum narrowing of the "eye chart" aperture, measuring of intersymbol distortions caused by low-frequency clipping, is calculated for signals in the form of voltage pulses with unity amplitude but duration variable from 1 to m time base periods ($1 \leq m < \infty$). Next is evaluated the dependence of this performance parameter on the transmission coefficient of the forward channel, on the transfer function of the low-pass filter in the feedback loop, and on the signal delay in the feedback loop. Practical realization of a "pure" feedback circuit for full suppression of low-frequency intersymbol distortions in accordance with this analysis must take into account technological problems of either minimizing the null drift at the resolver input with d.c. coupling or of adding an isolation capacitor in the feedback loop and scrambling the signal for replacement of d.c. coulping with a.c. coupling. Figures 5; references 6: 2 Russian, 4 Western.

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PRINCIPLES OF FEASIBILITY STUDY OF PROMISING COMMUNICATION TECHNOLOGY

Moscow ELEKTROSVYAZ in Russian No 9, Sep 85 (manuscript received 21 May 84) pp 7-9

[Article by B.I. Filippov and Ye.L. Smirnova]

[Abstract] This paper is concerned with the preliminary feasibility study necessary for the creation, introduction into production, and use of new technology. This includes as estimate of the economic effect as well as determination of a number of planned economic indices for the operation of enterprises, with allowance made for the use of new equipment. Increase in the reliability of radio transmitters is considered as an example. Figures 2; references: 5 Russian.

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SYNCHRONIZATION OF TRUNKLINE DIGITAL COMMUNICATION CENTERS

Moscow ELEKTROSVYAZ in Russian No 9, Sep 85 (manuscript received 25 Jul 84) pp 10-15

[Article by V.M. Barkov]

[Abstract] This work is concerned with: 1) Choice of a method of synchronization, taking into account pertinent recommendations of the CCITT (International Consultive Committee for Telegraphy and Telephony), of trunkline digital communications centers, which is cahracterized by long distances between synchronized objects; 2) Substantiation of the necessity for coupling synchronization networks with a standard time service; and 3) Consideration of problems of survivability of synchronization networks. It is concluded that: 1) Synchronization of trunkline digital communication networks must rest on time service; 2) It is advisable to divide a synchronization network into regions with respect to synchronization; to accomplish synchronization of generators within a region by a forced method, with selection of a special channel for this, 3) Reliability of the synchronization network is attained because the signal concerning fine adjustment of the phase of each generator of the trunkline network is taken by all incoming voltages; and 4) Survivability of synchronization is assured by the use of highly-stable (atomic) standards and resilient memory at all incoming directions. Figures 5; references 14: 10 Russian, 4 nonRussian.

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SIGNAL CONVERTER USED TO ESTABLISH MAIN DIGITAL CHANNELS ON A BASIS OF PRIMARY WIDEBAND CIRCUITS

Moscow ELEKTROSVYAZ in Russian No 9, Sep 85 (manuscript received 18 Jun 84) pp 15-17

[Article by A.M. Bograd, B.S. Danilov and L.G. Izrailson]

[Abstract] This paper is concerned with the problem of constructing a signal converter intended for forming two main digital channels in one primary wideband circuit and providing transmission of two digital flows at 64 kilobit/second each (UPS-64 x 2 PSh). The following are considered: 1) Properties of primary wideband circuits; 2) Choice of transmission method in UPS-64 x 2 Sh; and 3) Transmission of synchronization by bytes. Figures 5; tables 2; references 13: 7 Russian, 6 Western (1 in Russian translation).

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ORGANIZATION OF CONTROL SIGNAL TRANSMISSION BETWEEN ELECTRONIC EXCHANGES AND ARM-20 TRUNK EXCHANGES

Moscow ELEKTROSVYAZ in Russian No 9, Sep 85 (manuscript received 29 Mar 84) pp 18-22

[Article by Margitich Zdravko, Socialist Federal Republic of Yugoslavia]

[Abstract] This paper describes the technical solutions incorporated in the ARM-20, with the introduction of the "pulse packet" method instead of the decade multifrequency method of transmitting control signals. Both methods of the organization of control signal transmission between electronic exchanges and the ARM-20 are compared with respect to economy, simplicity of realization, and convenience of operation. Figures 8; tables 1; references: 2 Russian.

6415/9835
CSO: 1860/99

UDC 519.152

MEASUREMENT OF FLOW OF REPEATED CALLS AT AN AUTOMATIC LONG-DISTANCE TELEPHONE EXCHANGE

Moscow ELEKTROSVYAZ in Russian No 9, Sep 85 (manuscript received 24 Sep 84) pp 23-26

[Article by G.P. Ionin, P.P. Rotsens, M.A. Shneps and M.Ya. Yankevitsa]

[Abstract] The results are presented of traffic measurements made at the Rizhskiy Automatic Long-Distance Telephone Exchange (AMTS) in 1981-1983. Measurements were made with the aid of centralized equipment for cost accounting, developed and produced by the Rizhskiy Industrial Combine (VEF). Measurement of the AMTS load and its analysis was made with the object of determining the characteristics of the flow of calls, the quality of service for the subscribers and its conduct when there are repeated calls. The results of measurements were processed on a YeS computer according to a program developed at the Computing Center of the Latvian State University imeni P. Stuchka. Figures 3; tables 4; references 6: 3 Russian, 3 nonRussian.

6415/9835
CSO: 1860/99

UDC 681.3.02

MULTILEVEL MODEL FOR ELEMENT-BY-ELEMENT DIAGNOSIS OF HYBRID UNITS

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 7, No 5, Sep-Oct 85 (manuscript received 18 Apr 84) pp 61-64

[Article by N.P. Bayda and V.T. Shpilevoy]

[Abstract] In order to increase the effectiveness of diagnostic testing of hybrid devices, element-by-element diagnosis of hybrid units is increasingly used, allowing timely discovery of production printed circuit defects. This article analyzes problems of the design of diagnostic models required to formalize the process of element-by-element hybrid unit diagnosis. A multilevel model is described, differing from the traditional functional-logic model. The procedure of searching for possible defects in units is formalized by representing the printed circuit unit as a union of graph models. A list model is used at another level, completely reflecting all elements and parameters of the printed circuit board and its components. A combination of these models was used in planning of the automated system for element-by-element diagnosis of hybrid units containing discrete components and integrated circuits with various levels of integration. The model can also be used for diagnosis of more complex hybrid and digital devices in combination with functional testing. Figures 1; references 15: 13 Russian, 2 Western.

6508/9835
CSO: 1860/70

UDC 681.32.001.4+681.324:681.3-192

ALGORITHM FOR SELF-DIAGNOSIS OF COMPUTER SYSTEMS WITH PROGRAMMABLE STRUCTURE

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 7, No 5, Sep-Oct 85
(manuscript received after revision 28 Nov 83) pp 20-26

[Article by Yu.K. Dimitriyev]

[Abstract] Computer systems with programmable structure are living modular systems, their functioning based on the use of decentralized control algorithms. These systems, containing 10^4-10^6 computational modules, each of which is a complete computer, can continue to operate with multiple failures of modules. Diagnosis is performed by having the modules test each other. Determination of the state of the computer system consists of identification of points on the graph representing its state corresponding to operational syndromes. Any module can be considered a core module in such a system. The problem is to locate at least one clearly functioning module based on the results of mutual testing by modules, any number of which may be defective and thus yield improper test results. An algorithm for isolation of a core of properly functioning modules is presented. Conditions of automation of the determination of the state of such modular, living computer systems which can be diagnosed and repaired are analyzed. Determination of their state is a modification of the known method of uncoiling. Imitation-statistical modeling is used to demonstrate the effectiveness of heuristic decentralized self-diagnosis algorithm presented. Figures 2; references: 5 Russian.

6508/9835
CSO: 1860/70

UDC 681.3

PARAMETRIC OPTIMIZATION OF ROM WITH GEOMETRIC CODES

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 28, No 8, Aug 85 (manuscript received 14 Aug 84) pp 29-31

[Article by Yu.D. Chekmarev, Yu.F. Mukhopad and V.B. Smolov, Leningrad Electric Engineering Institute imeni V.I. Ulyanov (Lenin)]

[Abstract] The number of required connectors can be decreased in a geometric code Read-Only Memory [ROM] by increasing the number of groups, but this reduces optimality. A second method is described in this article, involving redistribution of digits to achieve the optimum number of interconnecting elements, then forming additional groups of the high order digits. A ROM of this type with a capacity of 8K 24 bit words requires 16 bus connectors instead of 64. The total number of pins is decreased from 256 to 96. References: 7 Russian.

6508/9835
CSO: 1860/63

UDC 681.325

INCREASING EFFECTIVENESS OF TEST SYNTHESIS FOR CIRCUITS WITH MEMORY

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 28, No 8, Aug 85 (manuscript received 3 Jan 85) pp 31-35

[Article by O.F. Nemolochnov, B.A. Kukushkin and R.T. Khamdamov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Estimates indicate that up to 80% of the volume of LSI microprocessors consists of internal memory registers, creating significant computational difficulties in test synthesis. Identification of microprocessor LSI memory allows production of a compressed model retaining one fragment of the repeating portion of the chip, for which the test is much more rapidly computed than for the initial full chip. A method is suggested for identification of memory locations to increase the effectiveness of test synthesis for circuits with internal memory registers. The test format remains the same for the initial and reduced models. Conversion of the test decreases its dimensionality and the time required to synthesize it. It does not influence the completeness of the test. Figures 2; references: 5 Russian.

6508/9835
CSO: 1860/63

UDC 621.3.032.269.1.01

SERIES EXPANSION OF ABERRATION COEFFICIENTS CHARACTERIZING CATHODE SYSTEM OF ELECTRON-OPTICAL DEVICES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85 (manuscript received 29 Aug 84) pp 1814-1820

[Article by M.B. Nesvizhskiy]

[Abstract] For design and performance analysis of the cathodic system in electron-optical devices in accordance with the theory of aberration, series expansion of the coefficients of third-order aberration in $\sqrt{\varepsilon}$ (ε-axial component of initial electron exit velocity) is proposed. The coefficients of these series characterize chromatic fourth-order aberration. Such an expansion is considered for a cathodic lens at zero potential in combined electric and magnetic fields. The expansion is performed after the third-order electron trajectory has been described in dimensionless complex variables. The correctness of this expansion is verified on the model of a cathodic lens in a central electric field, which yields the same fourth-order coefficients. References: 9 Russian.

2415/9835
CSO: 1860/87

UDC 538.945:621.385.6

HIGH-SPEED ELECTRONIC ANALOG OF JOSEPHSON JUNCTIONS AND SUPERCONDUCTING QUANTUM INTERFEROMETERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85 (manuscript received 27 Jan 84) pp 1768-1775

[Article by V.K. Kornev and V.K. Semenov]

[Abstract] A new electronic analog of a single Josephson junction and superconducting quantum interferometers is constructed for simulation of intricate regular or random phenomena. Its principal two parts simulate respectively the superconduction current through a junction as

$I_s = I_c \sin\phi$ (I_c- critical current) and its phase $\phi = \frac{2\pi}{\phi_0} \int_0^t V dt$ ($\phi_0 = h/2e$ - $- 2 \cdot 10^{-15}$ Wb - magnetic flux quantum, V- voltage across junction), even when the phase is an unbounded function of time under a junction voltage $V \neq 0$. Its third part simulates the other two current components and their sum plus the superconduction current. Its fourth part simulates the nonlinear phase dependence of the quasi-particle current. In the model of two-junction interferometers one can form a linear combination (algebraic sum) of the two phases and allow it to increase infinitely in time, or form the difference between the phase of each corresponding reference oscillator at fixed frequency F_0 and the controlled oscillator at frequency F proportional to the analog signal representing the junction voltage. Both methods, implementable with operational amplifiers, are demonstrated on the current-voltage characteristic of a tunnel junction with two values of the normalized capacitance $\beta = (2\pi/\phi_0)R_n^2 I_c C$ (R_n- normal resistance, I_c- critical current). Both the speed and the accuracy of these two variants of the analog model are higher than those of the conventional RSJ model and the nonlinear RSJN model. Both variants are extendable to arrays of N Josephson junctions and M flux quantizing circuits, requiring an analog with M circuit for simulating the superconduction currents and N-M circuits for simulating the other current components and adding them. The authors thank V.V. Migulin for interest and K.K. Likharev for valuable suggestions and for discussing the results. Figures 7; references 13: 1 Russian, 12 Western.

2415/9835
CSO: 1860/87

UDC 621.384.22:621.565

THERMOELECTRIC COOLING OF RADIATION RECEIVERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 24 Mar 83) pp 12-14

[Article by Ye.A. Kolenko and V.A. Orlov]

[Abstract] Thermoelectric cooling devices based on the Peltier effect can generate temperatures as low as -73 to -83°C, have small mass and size, low power consumption, long service life and great operational reliability. This article describes an instrument combining a radiation receiver and thermoelectric cooling battery in a single evacuated cavity. By using modern technological approaches and decreasing parasitic heat influx, thermoelectric batteries made of materials with a Q (amount of heat) = $= (2.5 - 2.8) \cdot 10^{-3} °C^{-1}$ can achieve reductions in radiation receiver temperatures of 140°C. As the parameters of thermoelectric materials are improved, the maximum temperature drop can be still further increased. Figures 2; references: 4 Russian.

6508/9835
CSO: 1860/98

UDC 621.382.2.026:621.382.3.026

ANALYSIS OF PROCESS OF CONNECTION OF HIGH VOLTAGE DIODE-TRANSISTOR SWITCH IN PULSE CONVERTER CIRCUIT

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 8, Aug 85 (manuscript received 30 Oct 84) pp 50-53

[Article by B.I. Grigoryev and Yu.V. Rezanov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] A model is suggested of the process of switching of high voltage power transistors in a converter with an inductive load, shunted by a diode. The converter circuit, based on a high voltage diode-transistor switch, is illustrated in a schematic diagram. Time diagrams of the operation of the converter are also presented. A model converter following the circuit presented in the figure was used to test the reliability of the model suggested. All combinations of high voltage power transistors and shunting diodes tested agreed satisfactorily with calculated data using the model suggested. Figures 1; references: 6 Russian.

6508/9835
CSO: 1860/63

UDC 537.533.3

RESTORATION OF TWO-DIMENSIONAL SIGNALS WITH MINIMUM NUMBER OF READING POINTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 8, Aug 85 (manuscript received 25 Apr 84) pp 59-65

[Article by V.I. Kalinchuk, Leningrad]

[Abstract] A method is developed for constructing a system of scanning trajectories with three-dimensional digitization of two-dimensional brightness fields with various correlations and space-frequency characteristics providing the minimum or assigned error in restoration with minimum number of reading points. The method of digitization and restoration of two-dimensional brightness distributions is difficult to implement in hardware, but can be successfully applied for the transmission, storage and synthesis of images of complex three-dimensional distributions of brightness fields by means of computers. Figures 5; references: 3 Russian.

6508/9835
CSO: 1860/63

UDC 537.533.3

PRINCIPLES OF THE THEORY OF RECEIVERS BASED ON THE THERMOELASTIC EFFECT FOR MEASUREMENT OF HARMONICALLY MODULATED RADIATION FLUXES

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 8, Aug 85 (manuscript received 18 Jun 84) pp 72-80

[Article by G.G. Ishanin and G.V. Polishchikov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] The author's Institute has developed a new type of thermal radiation receiver for precision photometry, based on the thermoelastic effect in a solid. The thermoelastic receiver is based on successive transformation of the modulated radiation flux which strikes it to heat field energy, which, due to its unsteadiness, causes unsteady thermoelastic voltages in its elements, which can be converted to electrical signals by means of tensometric devices. The tensometric devices used at the Institute consist of a measuring plate of crystalline X-section quartz 0.1 mm thick with nickel electrodes attached by epoxy adhesive to a damper which acts as a heat sink and high frequency oscillation damper. This article presents a detailed analysis of the amplitude-and phase-frequency characteristics of the homogeneous thermoelastic receivers, required for planning of high precision photometric devices. The parameters of thermoelastic effect receivers made with crystalline quartz at the authors' Institute are presented in tabular form. Figures 2; references: 7 Russian.

6508/9835
CSO: 1860/63

UDC 537.533.3

ERROR IN OPTICO-ELECTRONIC DEVICES WITH QUADRANT SECTIONAL PHOTODIODE

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 8, Aug 85 (manuscript received 30 Oct 84) pp 83-85

[Article by A.V. Nuzhin, E.D. Pankov and A.N. Timofeyev, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Quadrant sectional photodiodes combined with a special processing circuit can obtain independent static characteristics for two coordinates. However, these elements, due to technological errors in manufacture, have differing integral sensitivity of areas which may vary with time. This causes errors in measurement, which are analyzed in this article. Signals from each of the four areas are added in pairs, then subtracted, obtaining two signals, proportional to shifts in the distribution of luminance along two coordinates. Changes in integral sensitivity

lead to measurement errors which depend on the mismatch between the coordinates. Since the information signal processing circuit includes several adders, expressions are derived in this article which can be used to determine requirements for accuracy of addition and subtraction as well as accuracy of characteristics of the photodiodes. Figures 2; references: 2 Russian.

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UDC Δ621.9.06-529

RADIAN SYSTEM OF NUMERICAL PROGRAMMED CONTROL

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 10, Oct 85 pp 18-19

[Article by S.V. Suyarko, candidate of technical sciences, A.P. Reshetnikov and V.N. Grinchenko, engineers]

[Abstract] A functional diagram of the Radian system of numerical programmed control (SNPC) and its technical characteristics are presented. The Radian SNPC is intended for control of the angle of rotation of the chuck plate of a special turning-drilling-milling lathe during drilling and milling operations. The system is used at various enterprises in Kramatorsk. The economic saving for Radian lathes is determined by increased productivity and the elimination of time spend on the preparation, installation, and setting up of jigs with which drilling components were produced earlier. Figures 1.

6415/9835
CSO: 1860/139

UDC 681.142.2:65 Δ 65.011.56

ALGORITHM FOR CONTROL OF AUTOMATED MACHINING SECTION IN REAL TIME MODE

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 10, Oct 85 pp 34-35

[Article by V.I. Belov, engineer]

[Abstract] An automated machining section is described with the aid of a logical diagram. The section has a work place which can be either robotized or conventional with reception positions for instrument packs and components. The automated storehouse is equipped with a loading-unloading device which connects to the shop's store or the dispatcher department. The instrument packs and components can be moved from the storehouse to the work place and vice versa. A computer stores and feeds

production standard and operational information; takes control decisions in response to inquiries from the work place; operates the transport; distributes to the production and planning offices of the shop the tool-room documents necessary for production and lays out the work of the section for planning periods of less than one month. The Novosibirsk Heavy Machine Hydraulic Press Plant developed for a nonautomized mechanized section a simulation model intended to establish a working plant for one month. The simulation models can be used to develop a real time automated control program. The automated section is controlled by three functional modules (illustrated) which operate in automatic, semiautomatic and debugging modes. Figures 2.

6415/9835
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UDC 681.511.42.037:621.376.54

DETERMINATION OF FULL STEADY ERROR IN SYSTEMS WITH PULSE-WIDTH MODULATION OF THE FIRST AND SECOND KINDS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 8, Aug 85 (manuscript received 27 Dec 84) pp 13-18

[Article by S.V. Puchko and G.A. Komirnyy, Leningrad]

[Abstract] A study is made of the problem of determining the full steady error in systems with pulse-width modulation of the first and second kinds. The general approach to solution of the problem was presented in a previous work and is not described here. It is assumed that the linear continuous portion of the system is static and has first order astatism with respect to the controlling and disturbing effects. Figures 4; references: 3 Russian.

6508/9835
CSO: 1860/63

UDC 62.50

METHOD OF SEARCHLESS EXTREMAL REGULATION OF A SECOND ORDER OSCILLATING OBJECT

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE
in Russian Vol 28, No 8, Aug 85 (manuscript received 17 Sep 82) pp 24-28

[Article by B.P. Ryazanov, Moscow Institute of Power Engineering]

[Abstract] A study is made of an object operating under conditions of harmonic change of the input signal. Maximum productivity of the object is achieved when it functions at the extreme of the amplitude-frequency characteristic. The status of the object corresponding to the extreme of the amplitude-frequency characteristic can be described by three parameters: the modulus and argument of a complex transfer coefficient, plus frequency. Only the modulus achieves its extreme value under the conditions desired. A method is suggested for searchless determination of the extreme under these conditions. If the frequency of the input signal of the object does not correspond to the maximum of the amplitude-frequency characteristic, a nonzero error signal is generated at the output of the computer. Figures 2; references: 6 Russian.

6508/9835
CSO: 1860/63

UDC: 621.326.7

PROBLEMS OF HEAT EXCHANGE IN HEAT LAMPS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 6, Jun 85 (manuscript received 4 Jun 84) pp 86-91

[Article by A.N. Gordov, I.V. Rodionova and M.I. Shpakova, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Experimental data on the distribution of temperature along a strip filament with changes in filament position are analyzed. Studies were performed on series-produced gas-filled type SI-6-100 heat lamps with tungsten strip filaments. Studies were based on measurement of the distribution of brightness temperature along the hot portion of the strip with the lamp placed horizontally and vertically with three types of DC power applied, yielding currents of 5.87, 6.62 and 8.46 A. The experimentally established changes in vertical temperature gradient of the gas washing a vertically heated filament strip due to free convection decrease with increasing filament temperature as a result of the increase in gas flow speed. Experimental determination of the gas temperature around the filament allows more accurate allocation of the total power liberated in the lamp into convective and radiant components than do the empirical equations usually used. References: 4 Russian.

6508/9835
CSO: 1860/34

UDC 528.5

NEW GEODETIC INSTRUMENTS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 14 Jan 85) pp 29-33

[Article by A.I. Zakharov]

[Abstract] New optical-mechanical instruments put into production in the past two years are mentioned, including theodolites, a distance finder, and

a nomogram tachometer. Each of the instruments is briefly described. The improvement in Soviet geodetic instrumentation has allowed an increase in the productivity of labor in geodetic work. Most promising for the future are electronic-optical instruments, rather than optical-mechanical instruments, since they allow most complete automation of the measurement process. Organization of specialized enterprises for series production of peripheral information storage devices, data conversion devices and plotters is a necessity. Figures 9; references: 3 Russian.

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CSO: 1860/98

UDC 528.5

PHOTOELECTRIC ATTACHMENT TO UIM-29 AND DIP-1 INSTRUMENTS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 25 Apr 83) pp 33-35

[Article by Ye.R. Malamed, Yu.M. Olshevskiy, A.M. Ponkratov and Yu.S. Skvortsov]

[Abstract] A photoelectric fitting called the FEM-1 has been developed at the Leningrad Optical-Mechanical Union for the universal measuring microscope UIM-29 and 2 coordinate measuring instrument DIP-1, intended to direct the instruments toward light/shade boundaries arbitrarily located in the plane of measurement, such as the contours of nontransparent flat targets. The instruments can also be directed toward similar edges of periodic elements in products such as gears, screws, etc. The attachment operates wihtout increasing error with thicknesses of flat nontransparent objects up to 1.5 mm. With thicker objects, systemic error increases, and at a product thickness of 2.5 mm, it reaches 10 micrometers. The fitting allows direction to the edge of a curved object profile as well. However, error arises in this case since for curved profiles, the equality of ring and circle areas not covered by shadow images occurs in positions which depend on the radius of curvature of the profile R and do not coincide with the optical axis of the attachment. Studies have shown that the design is accurate in practical use. Figures 3; references: 2 Russian.

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UDC 621.385.632.19

EFFECT OF SHOT NOISE ON OROTRON FREQUENCY STABILITY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 19 Jan 84) pp 1802-1805

[Article by F.S. Rusin and V.P. Kostromin]

[Abstract] The effect of shot noise on the orotron frequency stability is analyzed, disregarding the forces of space charge in the high-Q open resonator. Excitation of the latter by an electron beam is assumed to occur at one natural frequency, with oscillations at all other frequencies forming the background noise. The differential equation for the oscillation amplitude contains a volume integral, namely over the product of current density and electric field intensity. Both steady-state and transient amplitudes are sought as solution to this equation, with excitation by shot noise explicitly included. The averaging time is assumed to be much longer than the electron transit time and much shorter than the resonator attenuation time. The relative frequency deviation or widening of the resonance line caused by shot noise is then calculated, assuming stable orotron oscillations and a product of limit cycle parameter and time much larger than unit. The expression for that frequency deviation is modified and simplified on the basis of relevant orotron performance characteristics, for comparison with the effect of shot noise in other microwave devices. References: 3 Russian.

2415/9835
CSO: 1860/87

UDC 537.874.2.001

PECULIARITIES OF ELECTROMAGNETIC-TO-MAGNETOSTATIC WAVE TRANSFORMATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85 (manuscript received 12 May 83) pp 1833-1835

[Article by V.P. Popov]

[Abstract] Transformation of an electromagnetic wave into a magnetostatic one, generally inefficient because of the large difference between the two wavelengths, can become quite efficient in a plane multilayer waveguide with a transversely magnetized ferrite. The latter matches the electromagnetic wave to the unidirectional magnetostatic wave through an intermediate unidirectional magnetostatic wave. A sectoral magnetostatic wave will efficiently transfer the energy from an electromagnetic wave to a unidirectional magnetostatic wave propagating through the gap between the ferrite and an ideal electric or magnetic wall. For illustration, the principle is demonstrated on transformation of the H_{10}-mode in a plane branching multilayer waveguide with electric walls and with a ferrite filling only $d<y<D+d$ of the cross-section. This ferrite is characterized by a dielectric permittivity and a tensor of magnetic permeability. Analysis and field calculations by the Wiener-Hopf-Fokk method and the Jones-Mitra-Lie method yield the necessary structure of the intermediate wave and the power efficiency of its transformation into a waveguide wave in an ideal lossless system. The efficiency becomes high and the expression for it simplifies for a magnetostatic wave propagating through a narrow gap $d/D<<1$ in one of the waveguide branches. Figures 1; references 4: 3 Russian, 1 Western (in Russian translation).

2415/9835
CSO: 1860/87

UDC 621.385.6

COMPUTER EXPERIMENT IN MICROWAVE ELECTRONICS (REVIEW)

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 10, Oct 85 (manuscript received 18 Apr 85) pp 5-22

[Article by A.A. Kurayev]

[Abstract] A computer experiment must reconcile two purposes, namely accurate simulation requiring a reliable and therefore elaborate mathematical model and efficient optimization requiring multiple access to that model. The general procedure is to formulate the problem of optimum interaction control with a system of ordinary differential equations of state, such a system being generally nonlinear and thus solvable only either approximately

or by numerical methods. Various procedures are available for minimizing the target functional J of the optimization problem, steepest descent for determining the components of its gradient and regular minimization of a function of many variables being most applicable to design and performance analysis of electron devices. Regular minimization of the zeroth order requires calculating only the functional $J(\vec{A}_k)$ for each value of the minimizing sequence $\vec{A}_k$, fastest and most stable being Nelder-Meed, Rosenbrock, and Powell algorithms of simplex minimization. Regular minimization of first order requires calculating also the gradient $gr_k = \partial J(\vec{A}_k)/\partial \vec{A}_k$, both the Davidon-Fltecher-Powell method and the Goldfarb method being fast and stable but the latter method being less error-critical and thus preferable for optimization of microwave electron devices. The formulation of mathematical models for these devices, namely systems of nonlinear differential equations describing the interaction processes in them is demonstrated on multicavity klystrons and O-type traveling-wave tubes, gyroresonance devices, and relativistic electron-beam devices. The results of optimization by computer experiment and graph plotting are shown for nonrelativistic, weakly relativistic, and strongly relativistic multicavity klystrons, gyroresonators, and relativistic electron-beam devices with generation or amplification of electromagnetic waves. Figures 6; references 67: 57 Russian, 10 Western (4 in Russian translation).

2415/9835
CSO: 1860/104

UDC 621.382.2

THEORETICAL STUDIES OF COLLECTORS IN MICROWAVE DEVICES (REVIEW)

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 10, Oct 85 (manuscript received 29 Apr 85) pp 22-34

[Article by V.M. Lopukhin, V.Ye. Rodyakin and A.N. Sandalov]

[Abstract] Theoretical performance analysis of collectors in microwave devices is essentially based on microscopic description of the charged-particle motion and macroscopic description of the electromagnetic field. The corresponding equations of electron ballistics and Maxwell field equations must take into account the still large number of molecules, mainly nitrogen molecules, present in vacuum devices even at residual pressures of only 10^{-6}-10^{-8} mm Hg. These equations, with appropriate boundary conditions, have been solved exactly for only a few special cases with simple regions and can in general be solved only approximately or by numerical methods. Most difficult is simulation of electric and magnetic fields, before the Poisson equation can be solved by either straight-forward or iterative methods. Analytic continuation is used for calculation of axisymmetric nonuniform external magnetic fields in the collector region, the problem becoming a three-dimensional one and much more difficult to solve for recently developed asymmetric collectors. As microwave devices

are being designed for higher power ratings, it becomes important to account more carefully for the increasing influence of space charge and of the intrinsic magnetic field on particles on the physical processes as well as for turbulence of the electron flux entering the collector during transients. These effects play a particularly significant role in the performance of collectors operating with high-intensity relativistic electron beams under accelerating voltages above 200 kV. Secondary electron emission from the collector walls, particularly appreciable in devices with longitudinal interaction, has also been simulated. In the case of low-perveance electron beams the backward current in the kinematic approximation is a sufficiently accurate measure. In the case of high-perveance electron beams only the continuous energy distribution and directional distribution of secondary electrons with their space charge will describe it adequately. According to energy as characterizing criterion, secondary electrons remain genuinely secondary below the 50 keV level but become inelastically reflected ones within the energy range from 50 keV to the energy level of primary electrons and elastically reflected ones when their energy exceeds that of primary electrons. Secondary emission thus complicates the already nonlinear self-consistent field problem and generally requires more approximations with regard to charge. Most interesting recent development are convective collectors, theoretically evaluated for low-power devices only, and recuperative depressed collectors mainly for traveling-wave tubes. Figures 7; references 27: 20 Russian, 7 Western.

2415/9835
CSO: 1860/104

UDC 621.372.852.3:621.372.837.4

SOLID-STATE MICROWAVE LIMITERS: PROBLEMS AND SOLUTIONS (REVIEW)

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 10, Oct 85 (manuscript received 1 Apr 85) pp 34-41

[Article by I.V. Lebedev, O.S. Shnitnikov and Ye.I. Kuptsov]

[Abstract] Radar stations with common transmitter and receiver antenna require not only efficient switching devices but also protective devices for the receiver circuits. As microwave power limiters for this purpose were first used resonance-type dischargers falling into the class of microwave gas-discharge devices. The recent trend is toward solid-state limiters, which offer the possibility of miniaturization and circuit integration in addition to the advantages of higher speed, better reliability, and longer life. The amplitude characteristic and the power dissipation of such limiters must be designed for operation during both transmission of strong signals and reception of weak ones, with the changeover from one mode to the other spanning a power difference of up to 2-0 dB and occurring within 10^{-8}-10^{-7} s. The performance of such limiters is analyzed on the basis of an equivalent parallel circuit with the limiter resistance shunted

by the load impedance in a configuration with the limiter connected between the antenna-transmitter circulator and the receiver. For automatic operation without external control signals, as self-controllable and thus "passive" device, a solid-state limiter must behave like a resonance-type limiter and a PIN diode with a thin i-layer meets this requirement most satisfactorily. The maximum operating frequency of this device depends largely on the thickness of that i-layer and raising it requires reducing that thickness. The resulting higher small-signal capacitance of the diode structure presents a problem which has been solved by using GaAs with higher mobility and drift velocity of charge carriers instead of silicon as diode material and by biasing the diode with direct current from an auxiliary microwave rectifier diode. The other major problem is power leakage and power-limitation threshold, both depending on the parameters of the limiter diode and both controllable by use of tuned step-up or step-down voltage transformers. Figures 8; references 52: 24 Russian, 28 Western.

2415/9835
CSO: 1860/104

UDC 621.382.2

STATE OF ART AND MAIN PROBLEMS IN DEVELOPMENT OF MILLIMETRIC-WAVE GUNN-DIODE OSCILLATORS (REVIEW)

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 10, Oct 85 (manuscript received 18 Apr 85) pp 42-50

[Article by N.A. Vasilyev, V.S. Lukash, V.V. Muravyev and V.I. Shalatonin]

[Abstract] Although Gunn-diode oscillators are theoretically most suitable for millimetric-wave heterodyne transmitters and receivers, in terms of bandwidth, nominal voltage levels, and noise characteristics, there are several problems which limit their manufacturability and application. One problem is the limiting upper cutoff frequency, associated with finiteness of the energy dissipation ability of these devices. Another problem is the shorter active region for shorter millimetric waves, which causes not only both power rating and efficiency to drop below acceptable levels but also creates technological difficulties in ensuring reliable performance and reproducible output characteristics. As the most practical solution to these problems is now considered extraction of higher harmonics, specifically second-harmonic or even third-harmonic generation. While analyses based on the appropriate equivalent circuit and on experimental data predict satisfactory results, as demonstrated on calculations for 40-50 GHz Gunn-diode oscillators with disk-type resonator, the criticality of operating conditions makes design optimization and manufacturability of 60-70 GHz Gunn-diode oscillators not so easily attainable. Figures 7; references 25: 6 Russian, 19 Western. (1 in Russian translation).

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SOLID-STATE MICROWAVE OSCILLATOR ON MIRROR-TYPE DIELECTRIC WAVEGUIDE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 10, Oct 85 (manuscript received 20 May 85) p 88

[Article by V.I. Pravda and A.A. Borisenko]

[Abstract] A mirror-type dielectric waveguide with rectangular cross-section on a metal substrate is considered for use as transmission line, because it not only ensures stable polarization of natural modes with a thinning of their spectrum but also is most easily manufactured and, as an open waveguide, easily clamped in place. The metal substrate acts as heat sink so that the active element in the waveguide will not overheat. The feasibility of installing an IMPATT-diode microwave oscillator in such a waveguide was studied experimentally, with Teflon as the dielectric material, with a power supply filter including a radial resonator, with an absorber disk, and with a movable short-circuiting plunger. The results indicate that an open plunger is not suitable here, because it lowers the oscillator efficiency to approximately 0.1% on account of its low standing-wave ratio (SWR = 10-15) and consequently high insertion losses in the radial resonator, but a closed plunger with a high standing-wave ratio (SWR = 30) will raise the oscillator efficiency up to 3%. The zone of the active element should be metallized, for higher efficiency and better electromagnetic compatibility. Figures 1; references 5: 2 Russian, 3 Western.

2415/9835
CSO: 1860/104

UDC 621.385.64

BUILDUP OF STEADY-STATE OSCILLATIONS IN M-TYPE OSCILLATORS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 10, Oct 85 (manuscript received 1 Oct 84) pp 63-68

[Article by V.I. Gomozov and E.G. Lamekhov]

[Abstract] Buildup of oscillations in M-type oscillators with bounded electron flux is analyzed according to conventional procedure for this class of devices. The equation of oscillations, derived on the basis of a fundamental-frequency and third-harmonic parallel equivalent circuit, differs from the Van der Pol equation by three terms on the right-hand side representing inertia of the electron flux and two components of the induced current respectively. The corresponding inductance and two capacitances, for the tangential component and the radial component of the induced current, appear accordingly as three additional branches in the equivalent circuit. The equation is solvable by the Runge-Kutta method of

numerical integration. The solution to this equation, unlike the solution to the Van der Pol equation, yields an aperiodic frequency transient along an aperiodic amplitude transient. Measurements made on a pulse magnetron for the 3-cm wave band and on a continuous-wave mitron for the 10-cm wave band confirm the results of computer calculations made on that basis. Figures 3; references: 11 Russian.

2415/9835
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UDC 621.385.6

SUPERHETERODYNE AMPLIFICATION AND GENERATION OF ELECTROMAGNETIC WAVES IN ELECTRON BEAMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 10, Oct 85 (manuscript received 2 Jul 84) pp 56-69

[Article by A.A. Silivra]

[Abstract] Superheterodyne amplification and generation of electromagnetic waves in an electron beam are analyzed as a problem of parametric interaction of two plane waves: signal wave traveling with the electron beam and pump wave traveling in the opposite direction. The electron beam is assumed to be infinitely wide and propagating through a medium capable of transferring gain to a signal wave from an idle slow space-charge wave generated in the electron beam. Calculations for the interaction space only, with zero amplitudes at both ends as boundary conditions, reveal an effect of spperheterodyning on parametric action at small increments of space-charge wave amplification already. Large amplification of a signal wave thus appears to be feasible, with the interaction shorter than its optimum length but with the pump wave intensity much reduced. This technique is particularly applicable to klystrons and traveling-wave tubes. Figures 1; references 8: 7 Russian, 1 Western.

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UDC 621.382.2.029.64

EXPERIMENTAL STUDY AND SIMULATION OF SOLID-STATE OSCILLATORS WITH OPEN RESONATORS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 10, Oct 85 (manuscript received 17 Oct 84) pp 50-55

[Article B.A. Kotserzhinskiy, N.A. Pershin and V.P. Taranenko]

[Abstract] An experimental and simulation study of solid-state oscillators with open resonators was made, for the purpose of design and performance evaluation. Two breadboard models were built and tested, each as a two-stage device with the active element, power supply, elementary radiator, and matching circuit in the first stage, and with the resonator feeding into the load through a coupling circuit in the second stage. A microstrip antenna was used as radiator, a rectangular resonant one being preferable on account of its widely adjustable input impedance and the diversity of its possible configurations. In one model the antenna, with air as dielectric filler, was placed at the center of the plane mirror forming the open resonator. Measurements have yielded the frequency dependence of all relevant admittance and impedance components, transmission coefficient and coupling coefficient of the "coaxial cable - microstrop antenna - open resonator - output waveguide" system in both directions. An analysis of the data reveals the behavior of a microstrip antenna as an inhomogeneity inside an open resonator and the effect of an open resonator on the antenna impedance. The results indicate the suitability of microstrip antennas for such devices and the simulation method employed here yields the information necessary for optimizing the oscillator design. Figures 7; references 10: 6 Russian, 4 Western.

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UDC 621.372.54

DIELECTRIC RESONATORS IN DECIMETRIC-WAVE FILTERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian
Vol 28, No 10, Oct 85 (manuscript received after revision, 23 Jan 85)
pp 96-97

[Article by V.T. Lis, V.A. Syzranov, G.A. Mirskikh and O.N. Bovkun]

[Abstract] The miniaturization problem in design and manufacture of hybrid-integrated devices such as multicavity resonators for decimetric-wave and centrimetric-wave filters can be more easily solved by using shielded dielectric resonators than by using open ones. Such a resonator is essentially a hollow waveguide with a dielectric filler, typically a segment of a coaxial transmission line short-circuited at one end. It can

be produced by pressing the dielectric material to required form and dimensions, then metallizing its surfaces by conventional film technology. A band filter with 1.6 GHz as center frequency has been experimentally built according to this principle with three quarter-wavelength resonators made of 1 mm thick TL/O ceramic with copper cladding. The no-load Q-factor of these resonators should be Q = 1000-1100. Parasitic transmission was not detected in the nearest multiple-frequency $2f_r$ = 3.2 GHz passband, only in the next $3f_r$ = 4.8 GHz passband, the filter performance thus exceeding theoretical expectations. The entire filter occupies a volume of 1.7 cm^3, while a filter having the same amplitude-frequency characteristic but built with three open dielectric resonators would occupy a volume of 59 cm^3. Figures 2; references 2: 1 Russian, 1 Western (in Russian translation).

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ESTIMATION OF MAXIMUM KLYSTRON EFFICIENCY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received 19 Sep 84) pp 20-26

[Article by A.V. Zvobin and F.G. Filimonov]

[Abstract] The maximum klystron efficiency attainable by design optimization is estimated theoretically, optimum selection of the frequency separation and the drift space length between cavities being essentially the only practical method now available. Analysis is based on the one-dimensional nonlinear theory of O-type devices. Calculations are made for multicavity klystrons with bunching of electrons at fundamental-frequency only and for klystrons using also cavities tuned to the second-harmonic frequency of the amplifier input signal. Optimum bunching conditions are assumed, stratification and lateral effects being disregarded. The results reveal that the saturation efficiency peaks sharply to the theoretical limit slightly above 90%, as the microperveance increases from near zero to the practical range of 0.2-0.4, and then drops softly below 80% or even 70% with the microperveance approaching and then exceeding unity. Results for 5-, 6-, 7-cavity megawatt klystrons indicate that the maximum efficiency either decreases to below 80% and then increases or increases above 80% and then decreases, as the ratio of bunching length to plasma wavelength is increased from 0.3 to 1.0, depending on the configuration of cavities. The relativistic effect makes the dependence on that ratio stronger. Increasing the number of fundamental-frequency cavities increases the maximum efficiency, but not as much as does increasing the number of second harmonic cavities. Experimental data generally confirm these results, although not all data are quite consistent and in agreement in specifics. Figures 2; tables 1; references 26: 20 Russian, 6 Western.

2415/9835
CSO: 1860/86

UDC 621.376.52

SHAPER OF DIGITAL MICROWAVE SIGNALS WITH COMPACT SPECTRUM AND CONSTANT ENVELOPE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received after revision 28 Jan 85) pp 26-29

[Article by L.G. Gassanov, R.V. Kiselev, N.I. Lelyukh, A.A. Lipatov and I.A. Tsikin]

[Abstract] A shaper of digital microwave signals is described which ensures not only a compact spectrum but also a constant envelope necessary for satisfactory operation of microwave relaying amplifiers in satellite communication systems. Formation of such signals by keying methods such as frequency keying with minimum shift is preferably done directly at the carrier level rather than conventionally at the intermediate level so as to avoid the use of mixers and filters with attendant generation of parasitic combination-frequency components during transfer of the signal spectrum from intermediate level to carrier level. The signal shaper consists of a microwave oscillator, a microwave amplitude modulator, and a timer, each with characteristics tailored for the particular microwave band, also a Lange interdigital quadrature bridge as power divider and a binary phase keyer, the latter built with microstrip components including an FTsP2-14 circulator, a transmission line segment of matched length, and a controlled type-3 2A-522 or 2A-517 pin-diode with a low-pass filter and a high-impredance trimming loop in its control circuit. The shaper generates minimum-shift frequency-keyed signals with a constant envelope at the microwave carrier levelwwith a frequency band not exceeding 10%. Figures 4; references: 4 Western.

2415/9835
CSO: 1860/86

UDC 621.375.031

MEASUREMENT OF PARAMETERS OF MILLIMETRIC DIODES AS WAVEGUIDE STUDS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received after revision 3 Dec 84) pp 54-60

[Article by B.A. Kotserzhinskiy and A.A. Parfenov]

[Abstract] A mathematical model of millimetric-wave IMPATT diodes commercially produced in the stud configuration is constructed, whereupon a procedure is proposed for determining the diode immitances on the basis of the equivalent circuit. The method of reference reactance loads (capacitive reactance of p-n junction in prebreakdown state) is applied to the stud and

the method of signal transmission (detection of modulated microwave signal) is applied to the semiconductor structure. The procedure consists of four steps: 1) determining the dependence of the equivalent diode capacitance on the bias voltage by measurements with a bridge; 2) measuring the stud capacitance, inductance, and resistance by the method of reactances, with supplementary computer-aided minimization of the difference between diode input impedance based on equivalent circuit and on reflection coefficient in coaxial waveguide respectively; 3) measuring the load impedance by the resonance method with the shorting bar in various positions; 4) calculating the conductance and the susceptance of the semiconductor structure from measurements of gain in the active mode. The immitance characteristics of a semiconductor structure can then be accurately approximated with analytic expressions based on regression analysis. The procedure is most expedient at shorter wavelengths. Figures 4; references 4: 2 Russian, 2 Western (1 in Russian translation).

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UDC 621.316.717-213.34.06:622

CONDITIONS FOR ARCLESS SWITCHING OF SUPPLY CIRCUITS ENERGIZING STARTER ELECTROMAGNETS FOR MINING EQUIPMENT

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 85 pp 3-7

[Article by V.I. Shchutskiy, doctor of technical sciences, V.S. Dzyuban, candidate of technical sciences, and V.K. Zhitnikov, engineer, Moscow Institute of Mining]

[Abstract] While the operation of d.c. contactors in control circuits for mining equipment during wide voltage fluctuations in the underground distribution network is fairly stable, their reliability is low on account of electric wear caused by frequent switching of circuits with a necessarily high inductance. This is demonstrated on electromagnetic starters. An analysis of current-voltage relations and transients in a circuit with a variable air (or inert gas) gap reveals the conditions under which the voltage across such a gap will not exceed the breakdown level and thus no arcing will occur upon opening of contactors. The wear of contactors will then be reduced to almost mechanical wear only and their life will thus be lengthened very appreciably. This requires a minimum voltage drop across the supply source energizing the starter electromagnet, not more than a few percent of the supply voltage. Article was presented by Department of Electrification of Mining Enterprises. Figures 2; references: 3 Russian.

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UDC 621.316.925.2.004.5

AUTOMATION OF TROUBLE-SHOOTING PROCESSES FOR PROTECTIVE RELAYING AND AUTOMATION EQUIPMENT

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 85 pp 12-17

[Article by S.F. Zhukov, candidate of technical sciences, assistant professor, Zhdanov Institute of Metallurgy]

[Abstract] Programming was designed for automatic trouble-shooting of protective relaying and automation equipment. It is based on the table of fault functions, according to Moore's synchronous finite automation as mathematical model, and a set of test programs for determination of time characteristics. Assuming that only one fault in the protective system can occur at any one time, for each kind of fault listed in the table there corresponds a specific response to the input signal. This response is encoded in the output signal, in the form of time intervals. The hardware of such a special-purpose automatic trouble-shooting system consists of a fault conditions and switching simulator with controls and display. The control module contains a timer, a comparator, two counters, one with a delay line, and three memories for storing codes of input actions, codes of time intervals, and codes of test object responses respectively. A universal fault conditions and switching simulator has been constructed for this application with voltage, current, and phase measuring and regulating capability. Article was presented by Department of Electric Power Supply for Industrial Enterprises. Figures 3; references: 3 Russian.

2415/9835
CSO: 1860/134

UDC 621.315.2.014.32/38:629.12

DETERMINING INSTANTANEOUS VALUES OF INTERACTION FORCES BETWEEN CABLE AND CHASSIS BY FREQUENCY METHOD

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 85 pp 26-31

[Article by G.N. Tsitsikyan, candidate of technical sciences, and V.G. Merkuryev]

[Abstract] A method is proposed for calculating the instantaneous values of electrodynamic forces between a cable and a metal chassis during transient periods such as one following a short circuit across the cable. It takes into account the magnetizing current and eddy currents which appear in the chassis. The problem is simplified by "periodization" of the

current-time curve so as to eliminate constant components and even harmonics, $i(t) = 2\sum_{k=0}^{N} \mathrm{Re}[\dot{I}_{2k+1} e^{j\nu_k t}]$ with the number N determined by the desirable accuracy of this approximation. The algorithms are somewhat different for slowly varying and fast varying periodic components, with the effective depth of field penetration correspondingly larger or smaller than the chassis wall tnickness and with the boundary conditions appropraite for each case. The determination of forces by this method was verified experimentally for a 3 mm thick sheet of structural steel 2.5 m long and 1.2 m wide spread 0.09 m under busbars of a KNR 3x35 3-phase cable connected in parallel and carrying a short-circuit current of 60.3 kA upon impact. Measurements and calculations were made covering a period of 0.04 s. Figures 3; references: 4 Russian.

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UDC (621.316.016.23:621.311.031).001.24

MINIMIZATION OF TOTAL LOSS TO ENTERPRISES IN CHARTING LIMITATION ON DEMAND FOR ELECTRIC POWER

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 85 pp 37-39

[Article by V.I. Gordeyev, candidate of technical sciences, assistant professor, and A.V. Demura, engineer, Novocherkassk Polytechnic Institute imeni S. Ordzhonikidze]

[Abstract] During a shortage of electric power the demand for it at enterprises must be limited, but charting the limitation and allocating the available power is difficult because of inadequate intercommunication and inspection. An algorithm is therefore constructed for minimizing the total loss to the national economy in such a situation. A dependence of the economic loss on the decrement of available power is known to exist and, because the form of this relation is not precisely known, it is assumed to be a linear one. According to this algorithm, the maximum permissible load reduction in enterprises with the lowest ratios of economic loss to power decrement is determined without the need to approximate that relation for optimum distribution of demand cutbacks among the key customers. Although nonlinearities have been formally eliminated, some nonlinearity is indirectly taken into account on the basis of more complete data. The algorithm also takes into account that load reduction can occur in discrete steps only. It yields not only the necessary demand limitation in enterprises but also the optimum distribution of cutbacks among their key customers. The algorithm has been programmed in PL-1 for any YeS computer. Article was presented by Department of Electric Power Supply for Industrial Enterprises. Figures 1; references: 3 Russian.

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UDC 621.3.017

REGRESSION ANALYSIS OF STEADY OPERATING MODES IN AUTONOMOUS ELECTRIC POWER SYSTEM FOR FLOATING OIL DRILL RIGS

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 85 pp 46-49

[Article by T.S. Atakishiyev, candidate of technical sciences, assistant professor, A.A. Baryudin, candidate of technical sciences, A.N. Mutalibov, candidate of technical sciences, and F.Z. Efendiyev, engineer, Azerbaijan Institute of Petrochemistry imeni M. Azizbekov]

[Abstract] Regression analysis on the basis of full factorial experiments is performed for an autonomous electric power system on "Shelf" floating oil drill rigs, such a system including not only diesel engines and synchronous generators which supply power to thyristor-type drives of oil drilling and processing equipment but also auxiliary sources of reactive power. The basic two operations demanding power are laying-and-hoisting and drilling, the amount of power demanded depending in each case on several factors. The experiments for these two operations are based on a linear model with a planning matrix for 2-level variation of independent factors, 3 factors (8 tests) for the laying-and-hoisting operation (1. total current drawn by windlass, 2. current drawn by asynchronous load and ship auxiliaries, 3. total current drawn from reactive-power sources) and 4 factors (16 tests) for the drilling operation (1. kvar drawn from reactive-power sources, 2. rpm of turntable, 3. pressure on scoop, 4. number of pump double-strokes). The ranges of their variation have been set so as to ensure feasibility of any combination of values without possibility of failure. In order to ensure sufficient accuracy of the regression polynomials in the middle range of both plans, it has been necessary to make them orthogonal second-order ones and accordingly add 8 tests at the center point to both. The resulting regression coefficients have been given the Student's significance test and the final regression equations have passed Fisher's adequacy test. Article was presented by Department of Electrical Engineering and Petroleum Industry Power Engineering. Tables 2; references: 1 Russian.

2415/9835
CSO: 1860/134

UDC 621.311.21-181.4(047)

PRESENT STATUS AND OUTLOOK FOR CONSTRUCTION OF SMALL HYDROELECTRIC POWER PLANTS ABROAD

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 85 pp 103-107

[Article by V.Ya. Karelin, doctor of technical sciences, V.V. Volshanik, candidate of technical sciences, and Ye.M. Natarius, candidate of technical sciences, Moscow Institute of Structural Engineering imeni V.V. Kuybyshev]

[Abstract] In recent years increasingly more attention has been paid worldwide to small hydroelectric power plants. Construction of such plants is underway under the leadership of the known American, West German, and Swiss manufacturers. Although plants with smaller than 10 MW capacity are not quite as economical as conventional larger ones, they still meet the economic criteria justifying their construction. The most serious problem is availability and cost of the power generating equipment, turbines with appurtenances taking up 18-30% and electric generators with associated apparatus taking up 15-20% of the total plant cost. There is a gr at deal of international cooperation involved in this trend of hydroelectric power development, with a very active participation of the United Nations supervising a 1981 program which covers 42 countries. The major supplier of small turbines to the world makret is now the People's Republic of China, already producing small turbines of up to 500 kW and of 0.5-10 MW capacity such as the 21 series of 85 sizes for pressure heads ranging from 2 to 612 m and flow rates ranging from 0.43 to 8.6 m^3/s. The association of manufacturers has developed recommendations, namely: Pelton wheels for heads above 200 m, radial-axial-flow wheels with spiral chamber preferably on horizontal shafts for 25-200 m heads or on vertical shafts with fixed blades for heads smaller than 25 m, and on vertical shafts with adjustable blades for very low heads. A recent development are 2-stage turbines. Speed and power regulators for small turbines must be as reliable as but less costly than those for large ones, mechanical governors being less costly but also less reliable than automatic speed regulators with thyristor or transistor controls and electronic power regulators with "ballast" load responding almost instantaneously to load changes. Swedish manufacturers are eliminating speed regulators as well as guide vane adjustment altogether, a penalty for this reduction of turbine cost being an up to 25% decrease of plant efficiency. They are also replacing synchronous generators with induction machines and are coupling shafts of interconnected turbines through gears. New structural materials are being developed and introduced for penstocks such as asbestos-cement in Austria or reinforced concrete with prestressed steel inserts in China. An important general trend worldwide is toward more extensive use of microcomputers for control of turbine-generator performance and water storage cycle as well as for computer-aided design of plant structures. Tables 1; references 14: 6 Russian, 1 Czechoslovak, 7 Western.

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UDC: 621.315.2.016.2.001.4

DETERMINATION OF POWER OF PORTABLE TEST APPARATUS FOR CABLE POWER LINES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 7, Jul 85 (manuscript received after revision 4 Feb 85) pp 24-28

[Article by V.F. Boykadarov and V.V. Platonov]

[Abstract] Testing of cable power lines is a large scale operation. Decreasing the mass of test apparatus can decrease the costs of such tests. However, this requires determination of the maximum design capacity of the test apparatus. Based on a study of the nature of change in voltage on a cable line during testing, the required power capacity of testing devices for 6-10 kV power cables is determined. With a linear rise in test voltage the greatest power fed into the cable lines is determined by charging capacity up to the moment of complete supply voltage rise. For most cable lines the required maximum power of the test apparatus is not over 300 W. Figures 2; references: 4 Russian.

6508/9835
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UDC: 658.26:621.31.019.3

ANALYSIS OF POSSIBLE RESULTS OF LOSS OF ELECTRIC POWER SUPPLY TO MOTOR VEHICLE PLANT METALLURGICAL SHOPS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 7, Jul 85 (manuscript received 20 Mar 85) pp 36-39

[Article by B.V. Papkov and Ye.M. Chervonny]

[Abstract] A study of eight metallurgical shops at a motor vehicle plant was used to estimate the economic consequences of a possible loss of electric power, considering interconnections among shops both within and outside the plant. Intermediate storage of products of the metallurgical shops before further assembly means that power loss over a limited time does not result in interruption of the production process of the entire plant. Estimation of the total loss caused by a loss of electric power under these conditions requires additional analysis of the results of disruption of normal production processes in all sections downstream from the metallurgical shops. References: 1 Russian.

6508/9835
CSO: 1860/33

UDC: 621.311.4:665.6

GENERALIZED ENERGY-ENGINEERING MODEL FOR ECONOMIC ESTIMATION OF THE RESULTS OF A LOSS OF ELECTRIC POWER

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA
in Russian No 7, Jul 85 (manuscript received 20 Mar 85) pp 39-41

[Article by V.I. Starostyn, V.L. Vyazygyn and V.V. Karpov]

[Abstract] The major components of economic loss resulting from a loss of electric power are rejected products and lost raw material, reduced life of equipment, wages and costs of restarting the equipment, and loss of profit due to a decrease in quality or output of end products. Losses can be determined by analyzing operating conditions of the process equipment in a petrochemical plant resulting from a loss of electric power. This energy-engineering model more completely and clearly reveals the essence and nature of changes in operating conditions of an enterprise in case of power limitations or emergency interruption of electric power supply, with or without warning. Figures 1.

6508/9835
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UDC: 621.31:658.56:519.95

ISOLATION AND DESCRIPTION OF ELECTRICAL CENOSES

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA
in Russian No 7, Jul 85 (manuscript received 19 Feb 85) pp 49-54

[Article by B.I. Kudrin]

[Abstract] The general terms and results are studied of an approach which explains the difficulty of standardizing electric power consumption, calculating electric loads and losses in electric power supply systems, and compensation of reactive power by the use of the concept of the electrocenosis, by analogy with a biocenosis: the description of an environment within which electrical equipment is used, including the species distribution, or distribution of types and sizes of electrical equipment within the electrocenosis, their interactions and their nutritional (power supply) and wasted generation (power losses and heat generation) characteristics. Figures 2; references 9: 7 Russian, 2 Western.

6508/9835
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COMPUTATION OF LOSSES WITH RANDOM CHANGE IN ELECTRIC POWER QUALITY CHARACTERISTICS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 7, Jul 85 (manuscript received 20 Mar 85) pp 60-63

[Article by I.G. Krakhmalin and Ye.B. Solntsev]

[Abstract] Equations are derived to determine the statistical characteristics of loss functions with random change in electric power supply quality. The expressions derived for estimation of the statistical characteristics of the loss function of other index can be used to evaluate measures to standardize electric power quality indices and analyze their influence on the technical and economic characteristics of electric power consumers. Figures 1; references: 4 Russian.

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UDC 621.311.172.004.58

INFRARED VISION MONITORING OF ELECTROTECHNICAL EQUIPMENT

Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 85 pp 73-75

[Article by D.C. Maslennikov, candidate of technical sciences, A.G. Konstantinov, V.N. Osotov, M.R. Parylis, A.M. Greditor and Yu.A. Fominykh, engineers, Sverdlov Power Institute, Ural Non-Ferrous Metal Maintenance Plant, Ural Heavy Electrical Machinery Plant]

[Abstract] It is shown that infrared vision monitoring is an effective means for evaluation of electrotechnical equipment and with an efficient system of diagnosis makes it possible to solve a wide range of problems of increasing the reliability of the national power supply. It is necessary to accelerate equipping of the country's power system with contemporary infrared vision equipment and to introduce infrared vision monitoring into producer plants for standard thermal tests of high-voltage apparatus. Operational technical documents should indicate the permissible temperature levels of the external surfaces of the equipment which characterize the thermal state of the contact systems of the equipment with a normal load and in overload conditions. Standardized documentation on infrared vision monitoring is required. Figures 1; tables 2; references: 2 Russian.

6415/9835
CSO: 1860/138

UDC 621.315.624.8.019.3

INCREASED RELIABILITY OF GLASS INSULATORS IN AREAS WITH INTENSE INDUSTRIAL POLLUTION

Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 85 pp 54-57

[Article by Yen Dar Kim, candidate of technical sciences, and S.V. Kuks, engineer, Special Production Design Office, All-Union Power Transmission System Insulation Industrial Association]

[Abstract] Investigations of the process of glass insulator breakdown were conducted during testing of insulators in fog chambers under conditions of intense discharges. This paper presents the results of laboratory investigations made at the above unit in order to increase the life of glass insulation cementing in areas with pollution. Figures 5; references: 5 Russian.

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DESIGN OF INCREASED CAPACITY OVERHEAD LINE

Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 85 pp 50-54

[Article by M.L. Feldman, candidate of technical sciences, North-West Division of All-Union Power Networks Design and Research Institute (Energosetproyekt)]

[Abstract] The paper is concerned with an overall approach to an increase of the real capacity of an overhead line as a function of the total surface of the conductors and the degree of its use with respect to the intensity of the field. It is concluded that, other conditions being the same, two-circuit or multicircuit designs do not increase the total real capacity. Creation of an overhead line using small section wires with an increased real capacity is only economically justified for failure situations and must be based on the system effect in each special case. Figures 6; references 9: 6 Russian, 3 Western.

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TEST OF STARTING-ADJUSTMENT AND SYSTEM TRIALS OF VYBORG RECTIFIER-INVERTER SUBSTATION

Moscow ELEKTRICHESKIYE STANTSII in Russian No 11, Nov 85 pp 44-49

[Article by V.P. Kulakov, engineer; N.S. Lazarev, V.V. Levchenko, N.K. Rakova, N.D. Alekseyeva, L.L. Balyberdin, A.I. Boyarskiy and Yu.S. Kraychik, candidates of technical sciences, All-Union Electrotechnical Institute imeni V.I. Lenin--Scientific-Research Institute of Direct Current (NIIPT)]

[Abstract] The paper discusses the principal stages and the most interesting results of trials of the Vyborg Rectifier-Inverter Substation, preceding its admission into industrial operation, as well as systematic trials together with Finland's energy systems. At the end of 1981, the USSR-Finland 330/400 kV electricity transmission with rectifier-inverter substation became operational with entry of direct-current into the city of Vyborg. By contract with the firm Imatran Voyma 4 billion kW hours of electrical energy is supplied to Finland each year. The start-up brings about connection of two asynchronously operating power systems and assures inertialess control of energy transfer to Finland. Figures 7; references 4: 2 Russian, 2 Western.

6415/9835
CSO: 1860/138

UDC 621.311.4.027.8.004.13-52

IMITATION MODELING OF ALGORITHMS FOR AUTOMATED TESTING AND CONTROL OF HIGH VOLTAGE SUBSTATIONS

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 7, No 5, Sep-Oct 85 (manuscript received after revision 11 Nov 84) pp 100-102

[Article by V.V. Bushuyev, V.I. Starostin and Ya.M. Shlemenzon]

[Abstract] One of the major problems in the creation of systems imitating the operation of automated systems for testing and control of high voltage substations is selection and demonstration of the primary functions performed by the control system at the substation. The authors have developed a model of such a control system, which is included as a part of a power system, allowing the effectiveness of various operating algorithms to be tested considering the influence of errors in measurement and noise in data transmission channels. The basis for creation of the model is the operational information system, which supports the collection, processing, display and recording of information on operating modes and technological parameters of

the substation. Failures in control system operation are found to occur even when there is no noise in the data transmission channels, indicating the need to improve reliability of existing testing and control hardware. Furthermore, noise in communications channels greatly reduces the reliability of switching, and noise protection is therefore required. Figures 2; references: 3 Russian.

6508/9835
CSO: 1860/70

UDC 621.373.826.372.99

DOUBLE PHASE CODING OF SPACE-FREQUENCY FILTERS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received 2 Jul 84) pp 73-75

[Article by M.N. Golubkova, S.A. Mayorov, and Ye.F. Ochin]

[Abstract] A space-frequency filter for a coherent-optical processor is described by a complex transfer function which, after discretization and staircase approximation, represents an array of rectangular elements with uniform amplitude transmission and phase transmission through each. Such a filter can be phase coded with two readings of the transfer function and thus two different pulse responses per element, instead of conventional phase or amplitude coding with only one reading and response per element. Anaanalysis of the transfer function of such a filter and of those two responses at (+1,0) and (0,+1) diffraction orders indicates that any one filter element can encode two complex readings of different transfer functions, if two sets of two transcendental equalities are satisfied. An alternative method of double phase coding, without solving a system of transcendental equations for each filter element, is representing each filter element as a 2x2 array of subelements with amplitude transmission 1.0 and phase transmission varying over the 0-2π range. With readings of the filter transfer function put in algebraic form, the solution to the corresponding system of four trigonometric equations for each filter element will appear in explicit form. Figures 1; references 5: 2 Russian, 3 Western.

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UDC 621.317.757

TWO-DIMENSIONAL ACOUSTOOPTICAL SPECTRUM ANALYZER EMPLOYING SPACE AND TIME INTEGRATION

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received 7 Mar 85 after revision) pp 76-78

[Article by Yu.V. Yegorov and A.I. Yeliseyev]

[Abstract] A two-dimensional acoustooptical spectrum analyzer employing space and time integration is examined in which a collimated laser beam is focused by a lens on acoustooptical modulators that are excited by a linear frequency modulated signal. The spectrum analyzer works by multiplying the three LFM signals used to excite the acoustooptical modulators and the analyzed signal, followed by integrating the product by charge accumulation on a photodetector. The operation of the device is analyzed theoretically, assuming that the acoustooptical modulators are working in the Bragg diffraction mode. In contrast to existing spectrum analyzers, the optical paths of the interfering light beams in the present two-dimensional analyzer are equal. Besides simplifying the optical system, this relaxes the requirements for the mechanical stabilization of the device and the coherent length of the optical source employed. Figures 1; references 6: 2 Russian, 4 Western.

6900/9835
CSO: 1860/126

UDC 621.391.019.4

NOISE TOLERANCE OF SIGN DETECTORS FOR OPTICAL SIGNALS

Moscow RADIOTEKHNIKA in Russian No 10, Oct 85 (manuscript received after revision 14 Mar 85) pp 78-80

[Article by R.G. Tolparev and E.V. Borisov]

[Abstract] An estimate is made of the noise tolerance of sign detectors for optical signals operating under conditions of asymmetrically distributed noise. The sign detector works by generating a test statistic and comparing it with a threshold. An expression is derived for finding the threshold from the formula for the false alarm probability. A procedure is defined for obtaining the estimate of the median of the noise distribution from a noise sample of a given size. Natural restrictions on the sample size change the false alarm probability. An expression is derived for estimating deviations of the false alarm probability from a calculated value, and for formulating requirements for the sample size in order to estimate the median for given deviation requirements. References: 1 Russian.

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UDC: 528.711

GENERAL MODEL OF TRANSFORM OF SPACE OF OBSERVATION IN SCANNING OPTICAL-ELECTRONIC INSTRUMENTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 28, No 6, Jun 85 (manuscript received 2 Apr 84) pp 54-58

[Article by A.S. Batrakov, Leningrad]

[Abstract] Further development of methods of modeling of scanning optical-electronic instruments is suggested, based on the idea of reducing the system to a dynamic central projection, in which the elements of external orientation of the photosensitive surface are functions of time. Possible formulations of the mathematical model of the scanning optical-electronic device providing for analysis of the specifics of formation of the image with various scanning elements and multiple-element receivers are analyzed. Possibilities for simplifying the initial model are studied. Figures 2; references: 8 Russian.

6508/9835
CSO: 1860/34

UDC 621.391.24

SELECTION OF CERTAIN PARAMETERS OF OPTICAL-ELECTRONIC SCANNING INSTRUMENTS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 4 Mar 85) pp 4-6

[Article by K.I. Schmelkov]

[Abstract] The quality of reproduction of a subject obtained with an optical-electronic instrument depends on the parameters of the instrument, particularly the absolute contrast sensitivity and transfer function. The transfer function or space-frequency characteristic (SFC) of instruments results largely from the transfer function of the electric filter at the output of the instrument. The more rapidly the SFC drops, the worse the reproduction of high spatial frequencies, subjectively perceived as a decrease in contrast and in resolution. However, effective quantitative criteria for estimating the influence of SFC on the reproduction of actual subjects have not previously been obtained. The purpose of this work is to fill this gap. Quantitative estimates are obtained of contrast and apparent resolution for a standard subject with an exponential spatial correlation function. A method is described for selecting the characteristics of the output low-pass filter. Figures 4; references 9: 8 Russian, 1 Western.

6508/9835
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UDC 535.513

MODULATION OF AXIAL LIGHT STRENGTH IN A SYSTEM WITH A QUASI-IDEAL CORNER REFLECTOR

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 12 Nov 84) pp 8-10

[Article by Ya.Z. Virnik, V.G. Vitozhents, V.B. Gerasimov, A.I. Dolgushin, M.V. Zakharov, V.I. Korneyev, A.Ya. Sagalovich and L.V. Sodovskaya]

[Abstract] It is established that for a non-ideal corner reflector with angles between reflecting faces not equal to pi/2, the energy striking a circle in the far zone at an arbitrary angular radius varies with the azimuth of the incident linear polarized light. This is contrary to previously published statements concerning ideal corner reflectors. When the plane of polarization of the incident light is rotated, the axial force of the reflected light, its intensity at the center of the reflection, undergoes periodic modulation. The effect of modulation of the light in a total internal reflection corner reflector can be used in devices utilizing polarization light modulators and the increase in axial light strength can be used in retroflector mirrors in laser distance finders. Figures 2; references 6: 5 Russian, 1 Western.

6508/9835
CSO: 1860/98

UDC 621.383.8

BACKGROUND INDUCED BY LIGHT SIGNAL IN BRIGHTNESS AMPLIFIERS WITH MICROCHANNEL PLATES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 12 Nov 84) pp 10-12

[Article by V.V. Borisov, B.Ye. Dashevskiy, A.M. Mechetin, and I.V. Persiyantsev]

[Abstract] A comparative estimate is presented of the parameters of image brightness amplifiers with microchannel plates in terms of contrast and spatial resolution as a function of the background induced by the incoming light signal. The studies were performed on modular brightness amplifiers with microchannel plates of invertor type. Images of a section of an optical standard were photographed from the screen of the brightness amplifier as short light pulses were applied to the photocathode. It was found that blackening the electrodes of the focusing system of the amplifiers increased the information capacity of the instruments in which they were used. Figures 3; references 3: 1 Russian, 2 Western.

6508/9835
CSO: 1860/98

UDC 539.3

NUMERICAL STUDY OF OPTICAL MIRROR TEMPERATURE DEFORMATIONS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 25 Oct 84) pp 26-28

[Article by S.M. Bauer, A.M. Kovanev, M.B. Petrov, V.V. Tikomirov and T.Ye. Tovstik]

[Abstract] A study is made of the axisymmetrical stress-strain state of a uniformly heated optical 2-layer mirror consisting of a metal substrate of variable thickness with a flat base and thin glass layer. The influence of such factors as the double layer nature of the mirror and difference in coefficients of thermal expansion of the substrate in the radial and circumferential directions on bending of the mirror are of interest. In a real mirror, these factors act together, but numerical experiments allow the factors to be considered separately. The model suggested allows calculation of the axisymmetrical stress-strain state of a uniformly heated optical mirror with known elastic and thermal parameters. If the tolerances for accuracy of optical mirror surface shape are known, the method can be used to determine the permissible thermal anisotropy and thermal heterogeneity of the substrate as well as the permissible difference in coefficients of thermal expansion of the substrate material and glass. Figures 4; references: 6 Russian.

6508/9835
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UDC 539.1.043:666.221

APPROXIMATION OF RADIATION-OPTICAL CHARACTERISTICS OF GLASSES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 31 Jan 85) pp 36-37

[Article by G.T. Petrovskiy, O.N. Bilan, B.A. Martsynkevitch, N.G. Cherenda and D.M. Yudin]

[Abstract] A study was made of multicomponent glass specimens to determine additional optical absorbtion arising as a result of gamma radiation of specimens in the dose range 10^4-$5 \cdot 10^6$ rad, temperatures 178--428K. Additional optical absorbtion spectra were found to have no clearly expressed bands, but could be divided into two areas, above and below 650 nm wave length. In the first area (350-650 nm) the increase in absorbtion with decreasing wave length is greater; at 650-850 nm this variation is not as strong. Additional absorbtion is significantly greater in the shorter wave length area than in the longer wave length area. Figures 1; references: 4 Russian.

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UDC 665.7;666.22

PETROLEUM POLYMER RESINS AS COLOPHONY SUBSTITUTES IN ADHESIVES FOR BLOCKING OPTICAL PARTS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 18 Dec 84) pp 39-42

[Article by M.M. Revyako, N.D. Gorshcharik and A.I. Kryukovsky]

[Abstract] Adhesives used for temporary attachment of optical parts in devices used for their subsequent processing contained 5 to 85% colophony by mass. The scarcity of colophony requires that replacements be found. A number of alkyl phenol petroleum polymer resins were studied to determine the possibility of partial or complete replacement of colophony in such adhesives. The deformation capacity, adhesion strength, solubility, flow index on substrates, tackiness, viscosity factor and softening point were determined. The data, presented in tabular form, can be used to determine the advantages and disadvantages of the resins tested as components in adhesives for mounting of optical parts. The resins oktofor AK and agidol 45 deform optical parts less and have greater tackiness than colophony. Oktofor N and Oktofor B are similar to colophony in their deforming capability and adhesive strength of the joint between steel and glass. Lower values of low-index for polymer resins require heating of joints to 10-15°C higher as they are formed. Figures 3; references: 6 Russian.

6508/9835
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UDC 535.317.6

USE OF TECHNOLOGICAL PLATES FOR ADJUSTMENT OF CERTAIN IR OPTICAL SYSTEMS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 13 Jul 84) pp 42-45

[Article by A.N. Krylov, A.B. Lysov and A.S. Filonov]

[Abstract] In spite of the advantages of adjustment of infra-red optical systems directly in the working spectral band, it is not yet possible to achieve high precision adjustment in the far infra-red. Therefore, in planning of optical systems with high requirements for image quality, the possibility of adjustment in visible light must be provided. This can be achieved for mirror optical systems, but plane-parallel plates such as filters are frequently required in such systems. The presence of such plates, frequently not transparent in visible light, makes adjustment in the visible light band quite difficult. This is usually done by replacing the plates with technological plates which are transparent to visible light. A mathematical method is presented for determining the required dimensions and characteristics of these plates to assure that adjustment performed in visible light

will be accurate when the device is used in infra-red light. The accuracy of adjustment using technological plates assuring agreement of the planes of best setting in the visible and IR bands is 30 to 40 times greater than when technological plates are used which provide equality of displacement of paraxial rays. References: 3 Russian.

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UDC 621.035

VISUAL RADIATION FIELDS OF INFRA-RED LASERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 9, Sep 85 (manuscript received 25 Feb 85) pp 54-62

[Article by Ye.P. Semenov]

[Abstract] A study is made of the simplest methods of visualizing IR images without electronic signal convertors, based on the use of optical conversion systems in which IR radiation is visualized by the use of the physical properties of materials or phenomena which change under the influence of heat. Visualizers discussed include the evapograph, luminescent visualizers, liquid crystal visualizers, absorbtion visualizers, visualizers based on thermochromic materials and thermosensitive paper, as well as films of iodine-polyvinyl alcohol, magnetic film visualizers, and photographic methods of visualization of laser IR radiation. Each of the methods of visualization discussed in the work has advantages and disadvantages. The basic characteristics of the visualizers for continuous and pulsed IR lasers are presented. Preference is given to visualizers based on thermochromic materials, thermophotographic paper as well as iodine-polyvinyl alcohol film-based visualizers. Figures 14; references 29: 24 Russian, 5 Western.

6508/9835
CSO: 1860/98

UDC 681.3.06:621,382.82.049,771.14

METHOD OF SOLVING THE PROBLEM OF MINIMIZING THE NUMBER OF TRANSITIONS BETWEEN LAYERS

Kiev ELEKTRONNOYE MODELIROVANIYE in Russian Vol 7, No 5, Sep-Oct 85 (manuscript received after revision 30 Jul 84) pp 42-45

[Article by V.A. Kalashnikov, V.P. Karelin and A.G. Korolev]

[Abstract] In designing integrated circuits, connections must be designed so as to minimize the number of connections between layers. In contrast to previously known heuristic solutions, this article suggests that this problem be reduced to a problem in integer bivalent programming, allowing well-known optimization methods to be used for its solution. All paths in the circuit are preliminarily distributed among major connections on the chip and subdivided into two sets, vertical and horizontal paths. The task is to find the minimum necessary number of transitions connecting sections of a single circuit located in different layers. A seven-step minimization algorithm is presented and it is demonstrated that the suggested approach allows construction of a mathematical model for the problem of minimizing the number of connections between layers, assuming that connections must be at junctions or bend points on the tracks. A global minimum can be found by the use of precise optimization methods. Figures 1; references: 8 Russian.

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CALCULATION OF CHARACTERISTICS OF SUBSURFACE-ACOUSTIC-WAVE FILTERS BY METHOD OF GREEN FUNCTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85
(manuscript received 28 Sep 84) pp 1713-1718

[Article by D.I. Mezhuyev, A.M. Zaslavskiy and S.G. Suchkov]

[Abstract] Since subsurface acoustic waves with anyypolarization in a crystal with any symmetry are piezoelectrically active and since the Green function for such a wave describes it completely in terms of its phase velocity and attenuation as well as piezoelectric power, it is necessary to determine that Green function in order to calculate the amplitude-frequency characteristic of any SSAW filter. Evaluation of the Green function is the sum of three components $G(x) = G_{es}(x) + G_{SAW}(x) + G_{VAW}(x)$ (electrostatic, surface acoustic wave, volume acoustic wave) is very laborious, even though at sufficiently far distances from the excitation source $\xi = x/\lambda_{SSAW}$ (λ_{SSAW}- wavelength of subsurface acoustic wave) $G_{VAW}(\xi) = A^{-\alpha(\xi)}e^{-j2\pi}$ alone will accurately describe the subsurface acoustic wave. A simpler method is use of equivalent circuits, assuming o-form excitation sources without reflection and regeneration. This is demonstrated on a shearing subsurface acoustic wave in an ST⊥X-cut quartz crystal and on a longitudinal subsurface acoustic wave in an ST||X-cut quartz crystal. The results of numerical calculations by this method are found to agree closely with the results of measurements made on an experimental pair of identical interdigital transducers in a lossy delay line, with a center frequency of approximately 270 MHz and with the distance between the two transducer structures varied over the $(200-700)\lambda_{SSAW}$ range. The authors thank V.V. Penzyakov for helpful discussions. Figures 4; tables 1; references 6: 4 Russian, 2 Western.

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DETECTION OF ACOUSTIC WAVES IN MULTILAYER PIEZODIELECTRIC-SEMICONDUCTOR STRUCTURE WITH PERIODIC ARRAY OF CONTACTS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 9, Sep 85 (manuscript received 11 Jan 84) pp 1866-1867

[Article by S.V. Boritko and G.D. Mansfeld]

[Abstract] Detection of surface acoustic waves in a multilayer piezodielectric-semiconductor structure is reported, such a structure having had a periodic array of contacts which produced an electric field alternating both in space and in time. The structure consisted of a YZ-cut $LiNbO_3$ crystal and a 1 μm thick CdSe film, with an interdigital array of ohmic (aluminum) contacts deposited on that semiconductor film. The electron concentration and mobility in the film were $n \simeq 3.5 \cdot 10^{16}$ cm^{-3} and $u = 200$ $cm^2/(V \cdot s)$ respectively. Acoustic waves were excited by an acoustoelectric transducer at a frequency of 56 MHz and, for facilitating the measurement, 30% amplitude-modulated at a frequency of 1 kHz. The detection characteristic, namely SAW detection voltage as function of input voltage across the contact bars, was measured first with a continuous semiconductor film and then with semiconductor film removed in all odd-number slots between contact bars. The linear detection characteristic in the first case and the square-law detection characteristic in the second case explain the nature of SAW detection as one unrelated to the acoustoelectric demodulation effect. A comparative evaluation of the data indicates that detection of acoustic waves with the aid of an alternating electric field is more effective than their detection on the basis of the acoustoelectric effect alone. The authors thank Yu.V. Gulyayev for support, A.G. Veselov and I.M. Kotelyanskiy for assistance in preparation of specimens, and L.A. Chernozatonskiy for helpful advice. Figures 2; references: 3 Russian.

2415/9835
CSO: 1860/87

UDC 621.372.543.2:534

SUBOPTIMUM METHOD OF SURFACE-ACOUSTIC-WAVE FILTER SYNTHESIS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 28, No 9, Sep 85 (manuscript received after revision 19 Oct 84) pp 92-94

[Article by V.M. Dashenkov and A.S. Rukhlenko]

[Abstract] A suboptimum method of synthesis is proposed for SAW filters consisting of two interdigital transducers. The calculations are appreciably

simplified and shortened, at an only slight sacrifice in accuracy, by a judicious reduction of the number of optimizable variables. The suboptimum filter will have almost the same overall frequency characteristic as the optimum one within the passband and only a slightly worse one outside it, an optimum Chebyshev filter serving as reference for comparison. The procedure consists of four steps, after the overall frequency characteristic of the filter $H(\omega)$ has been defined as the product of the two frequency characteristics $H_1(\omega)$ and $H_2(\omega)$ of the two transducers: 1) the optimizable function $H_2(\omega)$ is represented as the product of two functions $\bar{H}_2(\omega)\tilde{H}_2(\omega)$, with function $\bar{H}_2(\omega)$ selected a priori and remaining fixed throughout the next step; 2) function $\tilde{H}_2(\omega)$ is optimized within the bounded frequency band $\Omega_p<\Omega_{opt}<\Omega_\pi$, which yields a Chebyshev approximation, using the algorithm of discrete Fourier transformation and without checking the approximation outside the passband; 3) known window functions with a passband Ω_{opt} and sufficiently strong attenuation outside it are selected as function $\bar{H}_2(\omega)$; 4) the optimization process is completed with $\tilde{N}_2 = N_2-\bar{N}_2+1<N_2$ variables on the Ω_{opt} interval, using the algorithm of multiplicative approximation. This suboptimum method of synthesis has yielded a filter with a ripple not larger than $\pm$0.27 dB within the passband and an attenuation as large as -59.2 dB outside it, the corresponding optimum filter being one with $\pm$0.26 dB and -59.7 dB respectively. The method is particularly effective in synthesis of narrow-band filters with steep cutoff at both corners. Figures 2; references 7: 3 Russian, 4 Western.

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